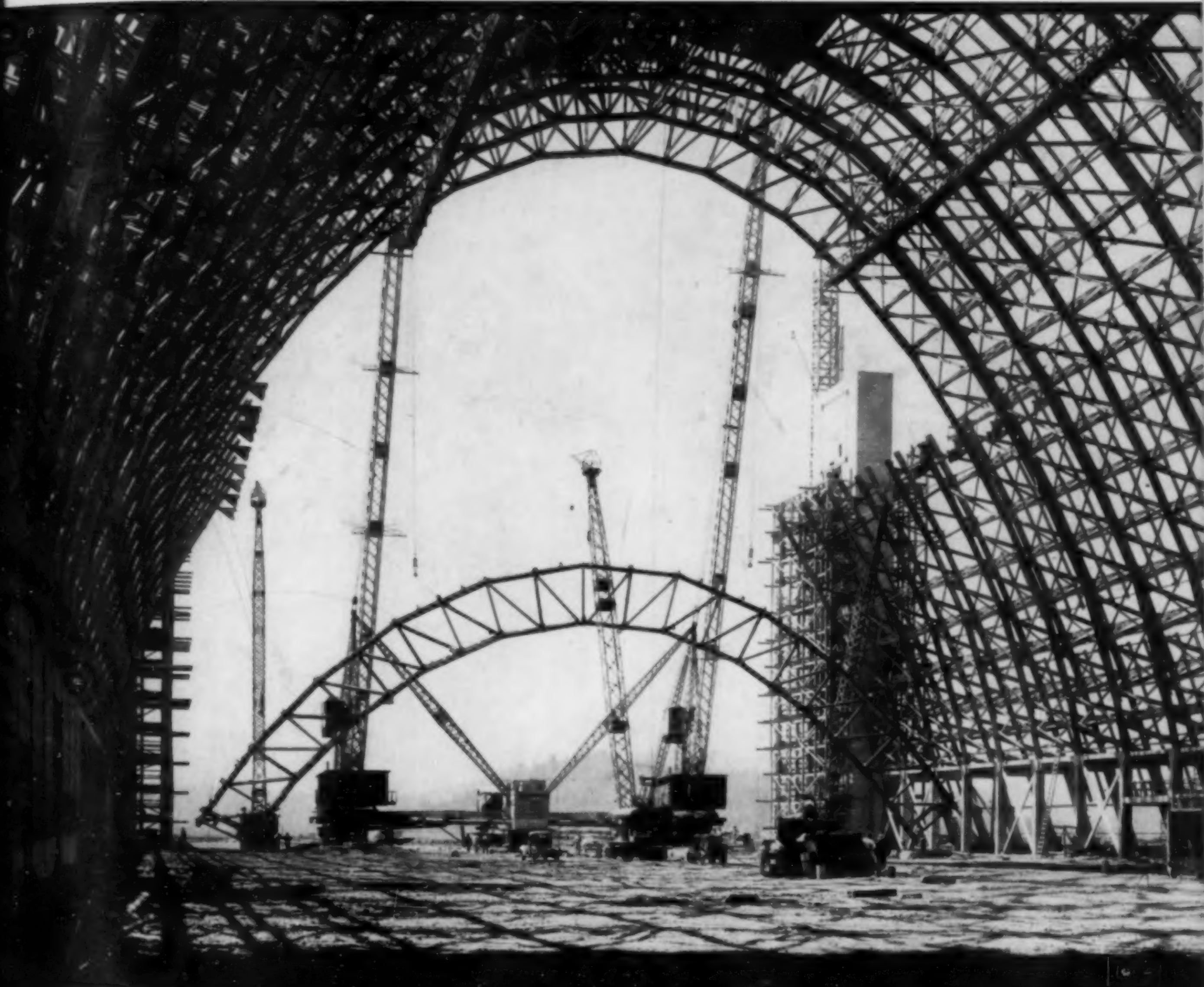
CIVIL ENGINEERING

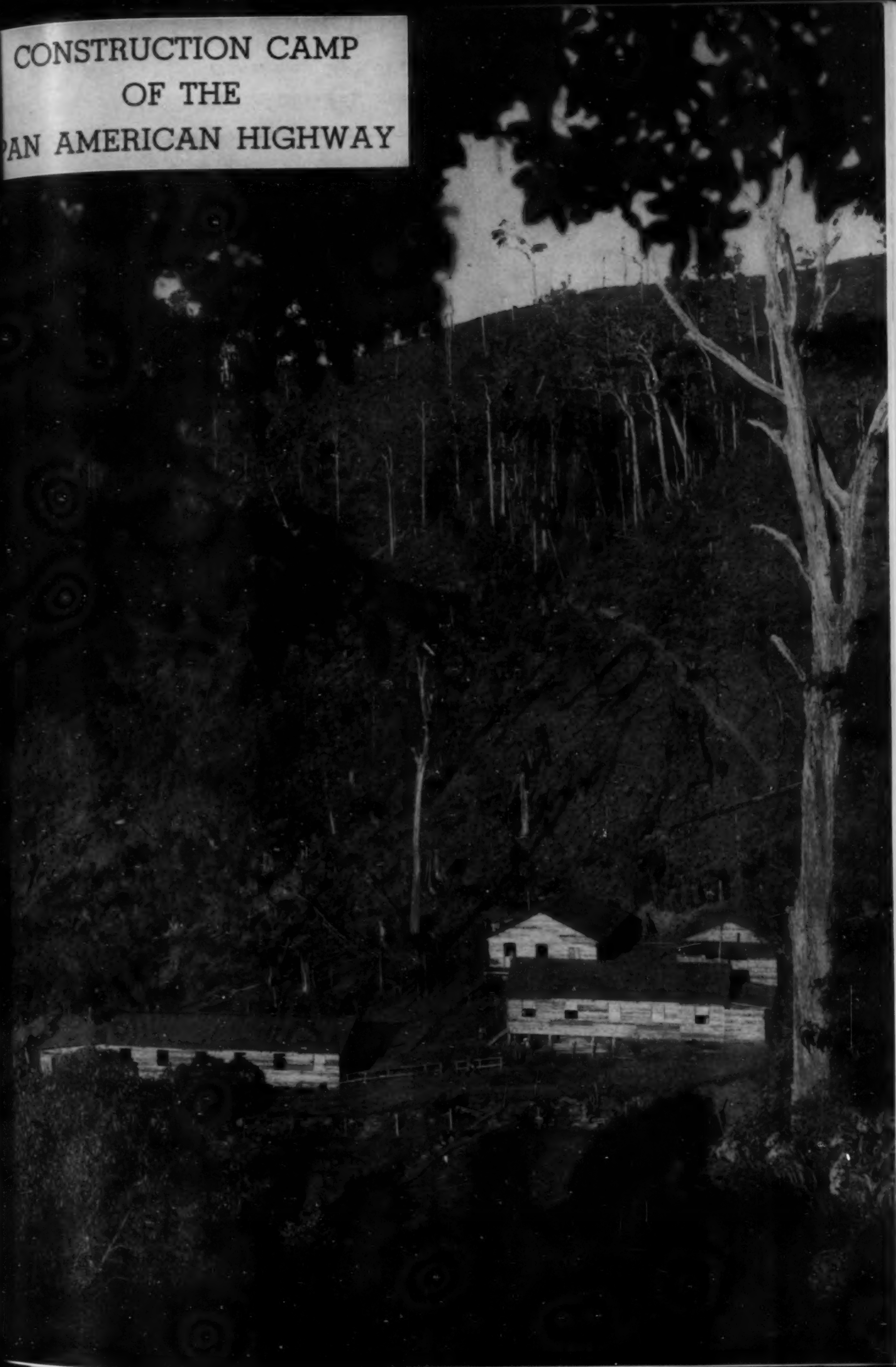
Published by the American Society of Civil Engineers



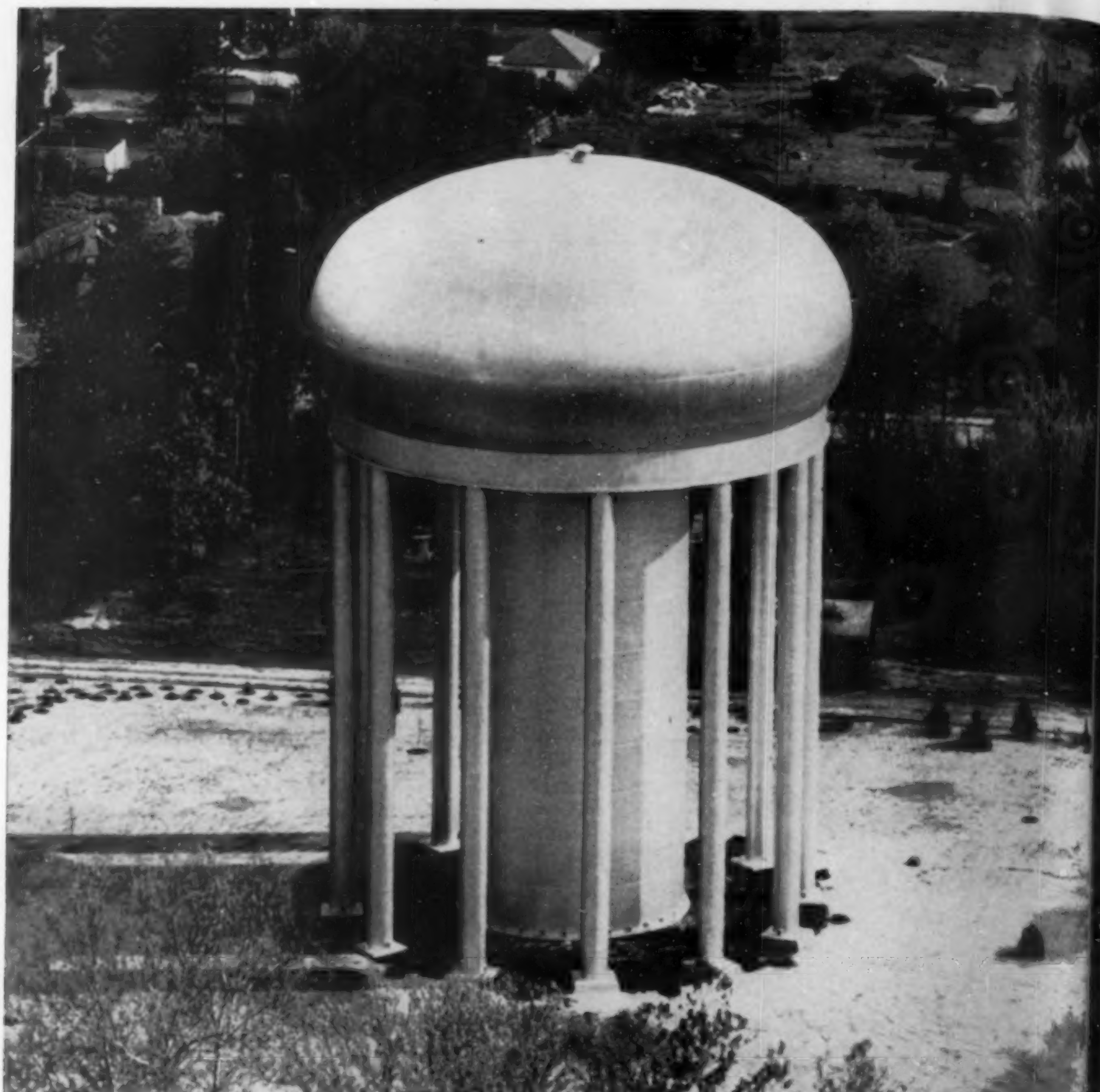
Traveling Cranes Erecting Timber Frame for Navy Blimp Hangar
Double-Rib Arch Segment, Weighing 21 Tons, About to Be Placed (See Article, Page 525)

Volume 13 AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852 *Number 11*

NOVEMBER 1943



CONSTRUCTION CAMP
OF THE
PAN AMERICAN HIGHWAY



Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Collective Bargaining and Salaries for Professional Engineering Employees

Bargaining Units Organized by Employee Members in Society's Local Sections

A MOMENTOUS step indeed has been taken by the American Society of Civil Engineers in the decision of the Board of Direction that leadership shall be assumed by the Society's members in the formation of collective bargaining agencies for "Professional Engineering Employees."

The Society has represented the civil engineering branch of the profession heretofore primarily in technological and educational matters. However for several years the Board of Direction and its advisory committees have studied and given expression to matters relating to the economic conditions of civil engineers. The question of salaries has been a particularly difficult problem but, from time to time, the Board has formulated and approved grade classifications and salary schedules which were used to promote the economic interests of engineers in instances where specific groups of engineers needed help.

In Recent Years, legislative enactments and legal decisions have given and upheld the rights of employees to bargain collectively. In accordance with these recent legislative enactments, the economic status of employees is now implemented by authorized group action. These group efforts have increased, until now all engineers who are employees are aware of the functions and possibilities of bargaining organizations. Some engineers have been forced to choose between an association composed largely of non-professionals or, without the formation of their own groups wherein a professional attitude can be maintained, to give up their jobs. To forestall such situations, the Board of Direction at its recent meeting at Atlanta approved a procedure recommended by its Committee on Employment Conditions, the objective of which is that the Society will sponsor and assist in collective bargaining procedures in behalf of professionally-minded engineers.

PRIMARY importance attaches, these days, to the crucial question of collective bargaining. Into this problem employee civil engineers have been drawn. By recent action of the Board of Direction, Society machinery is to be set up in a manner to be of greatest assistance to these professional men. President Whitman here presents the background of this development and the future procedure for meeting the issues.

At no time since its formation in 1852, has this administrative unit of the Society made such a momentous decision. By its Constitution, the Society is to work unceasingly for the "advancement of the sciences of engineering and architecture in their several branches, the professional improvement of its members, the encouragement of intercourse between men of practical science, and the establishment of a central point of reference and union for its members." Certainly none of these objectives could be gained by surrendering to non-professional groups the right to interpret employment practices for professionally-minded engineers. The alternative is the formation of bargaining agencies exclusively for professionals, directed by professionals, maintaining the status of professionally-minded engineers which has been earned by years of service to mankind.

The Growth Curve of collective bargaining can be plotted closely by a review of legislation pertaining to employee organizations. Successively, the Railway Labor Act in 1926; the Norris-LaGuardia Anti-Injunction Act in 1928; the National Industrial Recovery Act in 1923 and the National Labor Relations Act in 1935, all gave and upheld the right of employees to join together for collective bargaining purposes. In 1938 the Fair Labor Standards Act set minimum wages and maximum hours for employment. The U.S. Conciliation Service was formed in order to facilitate employer-employee relationships and to simplify the workings of the National Labor Relations Board. In order to expedite matters under wartime conditions, the National Defense Mediation Board, and later the War Labor Board, were formed and given the power, not only to conciliate differences between employer and employee, but to make mandatory decisions in these disputes.

These recent pieces of legislation were enacted to facilitate collective bargaining and thus collective bargaining groups have grown rapidly in recent years. It is reported that in 1933 there were 3,000,000 members of organized labor; in 1935 there were 4,000,000; in 1940, 9,000,000 and in 1942 more than 11,000,000 members out of a total of 42,000,000 wage earners. It has been only recently that any group action has been taken by pro-

fessional engineering employees. Several independent bargaining groups have been formed by professionally-minded engineers, such, for instance, as the Tennessee Valley Authority Engineers Association; the Technical Employees Association in Detroit and others.

In addition, two national aggregations of unions, recognizing the fact that many professional and technical employees were in need of group action, seized upon such conditions to bring professionals into associations with non-professionals for purposes of collective bargaining. These unions are the Federation of Architects, Engineers, Chemists and Technicians, formed in 1933 by the C.I.O., and the International Federation of Technical Engineers, Architects and Draftsmen's Unions, organized by the A. F. of L. A number of less active organizations affiliated with the A. F. of L. or the C.I.O. have been in existence for some years.

Wherever the Right of such organizations to include professionally-minded engineering employees has been challenged by interested groups, the War Labor Board has upheld the right of professionals to exercise group action in groups of their own choosing. In cases where the professionals have failed to act, non-professionals have assumed the right to bargain for the professionals and have been given that right by the War Labor Board. Thus, the "closed shop" agreement, in a number of cases, has placed the professional type of engineer within the jurisdiction of the union and has obliged him to surrender the privilege of bargaining with others of his kind for his own status. The dispute at the Sunflower Ordnance Works was a typical example of such a case. In this and similar cases, it has been shown conclusively that individuals cannot successfully resist inclusion in "closed shop" agreements and that they must resort to collective action in order to maintain their rights in appropriate units of their own choosing.

The American Society of Civil Engineers has consistently and actively opposed the inclusion of professional engineering employees, members of the Society or otherwise, in collective bargaining groups where they were outnumbered by non-professionals. It has reasoned that such inclusion was detrimental to independent actions and, therefore, to professional stature. With the encouragement of the Board of Direction a staff member has interceded in behalf of interested individuals or groups in attempts to gain recognition of the difference between a technician, on the one hand, and a professionally-minded and creative engineer, on the other. These activities have pointed the way to the need for group action by professional engineering employees in groups which are self-financed and self-administered and where the bargaining rights are delegated to representatives of their own choosing.

Stating that a most important factor influencing the present and future welfare of the professional engineering employee was his participation in the determination of his own field of activity and the recompense to be received therefrom, the Committee on Employment Conditions recommended, in its report to the Board of Direction on October 11, that agencies be established which could successfully bargain for the interests of professionals. "If the professionally-minded engineer is not prepared to bargain collectively through representatives of his own choosing," says the report, "collective bargaining will be done for him by representatives selected by an organization with which he may not wish to be identified."

After Due Deliberation and review of all factors affecting such vigorous action, the Board of Direction adopted the recommendations in the Report calling for the formation of collective bargaining groups by the employee engineers in the Society's Local Sections and defining the "Professional Engineering Employees" to be accepted into such groups. Included would be those registered engineers, engineers-in-training, members of engineering societies and others who will be found to conform to the terms of the definition.

To assure collective bargaining functions, the Board recommends to the 64 Local Sections of the Society that their Constitutions be amended so as to provide for the engineering employees within their respective areas to form such employee bargaining groups. The Society's staff, themselves employees, will act as the coordinating agency for such local units, rendering guidance. Within each Local Section, it is suggested that a "Committee on Employment Conditions" undertake the responsibility of protecting the interests of the professionally-minded engineers working in their respective areas through appropriate action when called for. This elected Committee is to be, at all times, responsive to the interests of those members and non-members of the Society who wish to be thus represented.

To Facilitate This Program, four experienced field representatives, one for each of the Society's geographical Zones, will be engaged. The experience and advice of these men will prove invaluable in organizing and guiding the local groups. Moreover, in many cases they may find it practicable to conciliate differences without the aid of the proposed bargaining groups.

As a corollary to bargaining procedures by these local groups, the Board of Direction adopted a Classification and Compensation Plan for Professional Engineering Positions in Major Engineering Organizations, defining several grades into which the work performed by civil engineers in such organizations is usually divided as experience and other capabilities dictate. Each clearly defined position and function is accompanied by the corresponding salary that should be paid.

The Society's Committee on Salaries, whose Report the Board adopted, specifies salaries to be paid to those newly graduated in engineering and to those engineers of greater experience for whom salaries of $9,600 and up per year are appropriate. The Report states clearly, moreover, that many positions of greater responsibility are not to be limited to that figure.

This Expansion of the Service which the American Society of Civil Engineers is continuously rendering the profession will affect in no unfavorable way, I believe, its values as a great technological and educational institution, but will supplement those values with others, related to the economic condition of those engaged in the work of the profession.

Geo. T. Whitman

PRESIDENT

Ezra B. Whitman
President

George T. Seabury
Secretary

Sydney Wilmot
Editor in Chief and Manager of Publications

Don P. Reynolds
Assistant Editor

CIVIL ENGINEERING

Committee on Publications

Ralph B. Wiley
Chairman

N. W. Dougherty
Ernest E. Howard
Scott B. Lilly
Fred C. Scobey

W. L. Glenzing
Advertising Manager

Volume 13 | November 1943 | Number 11

Army Reports on Pan American Highway

STRIKING southward through six Central American Republics, the section of the Pan American Highway under construction will provide a route from the Mexican border to Balboa on the Panama Canal. This road, more than 1,500 miles long, will have a minimum width of 16 ft and will be surfaced with crushed gravel or crushed stone. The entire project is under the supervision of the Corps of Engineers, U.S. Army, and the Public Roads Administration. Construction has been undertaken by certain of the Republics and by contractors from the United States. Transportation was one of the greatest difficulties to the constructors, and for surveys and early work it was necessary to carry personnel and supplies into remote regions by air. Although the first automobile trip over the length of the highway was completed in May 1943, considerable work is yet to be done before an all-weather route can be opened to traffic. The two articles following were presented before the Highway Division at the Los Angeles Convention of the Society.

Organization and Administration

By Edwin C. Kelton

Colonel, Corps of Engineers, U.S. Army; Director, Pan American Highway

UPON approval of the Pan American Highway project by the War Department, in June 1942, survey parties were mobilized to trace a route through extremely rough terrain from the Mexican border at Tapachula to Balboa on the Panama Canal. Negotiations were also undertaken with the six Central American Republics to be crossed to ensure their cooperation in the tremendous project. (See Fig. 1.)

Considerable preliminary work had been done through these countries by the Public Roads Administration, and estimates based on its knowledge of the project had been prepared. An agreement was reached with the Public Roads Administration (P.R.A.) that, where possible, the alinement of the pioneer road would follow that of the Inter-American Highway. It was also decided that where sufficient steel could be obtained, the P.R.A. would contract for the construction of permanent bridges along the alinement of the Inter-American Highway. The P.R.A. already had a program under way in accordance with Public Law No. 375, passed December 26, 1941, by the 77th Congress. This law authorized appropriation of $20,000,000 to construct and complete the essential portions of the highway through the Central American Republics, provided one-third of all expenditures were made by the interested countries.

For the construction of the military pioneer road, the War Department had made a decision that no engineer troops would be available for the construction work, and that the survey and construction would be done by civilian personnel under the supervision of Army officers representing the Corps of Engineers.

In Mexico the road had been improved from Nuevo Laredo by way of Mexico City to Oaxaca, a total distance of 1,108 miles. Between Oaxaca and the Guatemala border there remained approximately 530 miles to be constructed. All work in Mexico is being handled by the Mexican Government. However, there is a standard-gage railroad through Mexico from the United States to the Guatemala border at the Suchiate River crossing. Therefore supplies could be shipped to Guatemala by rail from any point in the United States.

In order to supervise the work from the field, an area office was established in Managua, Nicaragua, to look

Section of Completed Highway in Nicaragua

PIONEER ROAD UNDER CONSTRUCTION BY RALPH E. MILLS COMPANY IN COSTA RICA

after the work in the Republics of Guatemala, El Salvador, Honduras and Nicaragua. Another area office was established in San José, Costa Rica, to look after the work in Costa Rica and Panama.

An office was also established in Los Angeles for administration, mobilization, procurement of equipment and supplies, and control of shipping. The survey parties were transported by air to the area headquarters for distribution to their respective sections. All parties and equipment arrived in Central America during the month of July and were immediately transferred to the field to start surveys.

WORK IN GUATEMALA

In the Republic of Guatemala (Fig. 1), which is the second largest of the Central American Republics, considerable mileage of highway had been constructed throughout the country, there being 3,500 miles of usable roads connecting the various cities and centers of population. However, only a small portion of this mileage could be considered serviceable for all-weather use. Inspection of the route between the Guatemala-Mexico border and Guatemala City indicated that through the mountains it reached altitudes in excess of 10,000 ft, and that grades were so steep and curvatures so sharp that it could not possibly conform to the minimum design standards for the pioneer road. At these elevations the country is almost continuously shrouded in fog.

In addition, the existing surfacing was very light and would not be practicable on a military highway. Therefore, a lower route was investigated, connecting Guatemala City with the Talisman Bridge on the Mexico Border, by way of Escuintla, Mazatenango, Retalhuleu, and Coatepeque. Some relocations in the alinement would be necessary and the distance would be shortened somewhat.

From Guatemala City to the El Salvador frontier, the road in general will follow the recommended locations for the Inter-American Highway along Route 2 except for some relocation near El Progreso and Asuncion Mita. The Government of Guatemala was in accord with the proposed alinement. It had a well-organized highway department with a considerable amount of road construction equipment. It was the desire that they do the construction work in the Republic, using such equipment as they had, with additional equipment to be furnished by the War Department.

On this general basis, the contract was negotiated with the Government of Guatemala for the necessary reconditioning and relocating of the highway and surfacing. This contract would be done at cost with no profit to the Government of Guatemala. The route extends a total distance of approximately 307 miles and most of it would require reconditioning to care for military loads.

EL SALVADOR AND HONDURAS

El Salvador is the smallest of the Central American Republics and the most densely populated. Its Bureau of Roads has functioned since 1926 and has been most effective in its construction program, a total of 4,000 miles of roads having been built and 2,500 miles improved. A paved highway has been constructed from the Guatemalan frontier near San Cristobal through the capital, San Salvador, to the city of San Miguel. All this work has been done without financial aid from the United States.

The remaining mileage necessary for extension of the route to the Honduras frontier amounted to approximately 37 miles. This included an existing road 25 miles long between San Miguel and Santa Rosa, which would require reconditioning, and 12 miles of new construction between Santa Rosa and the Goascoran Bridge site. The Republic owned road-building equipment and desired to do the work with its forces. Therefore a contract was entered into with the Government of El Salvador whereby it would be reimbursed for the actual cost of the work. It was necessary to augment its equipment with shipments from the United States. Another important adjunct to the highway program in El Salvador was completed last year, again entirely at the expense of the Republic. This consisted of construction of the Cuscatlan Bridge, crossing the Rio Lempa. (See CIVIL ENGINEERING for December 1942, page 661.)

The alinement of the proposed Inter-American Highway across Honduras covers a distance of approximately 92 miles, from the El Salvador Border at the Goascoran River Bridge site to Espina on the Honduras-Nicaragua border. A cost-plus-fixed-fee contract was negotiated for the construction of this route with the firm of Swinerton-McClure-Vinnell, which proposed to furnish the major portion of the necessary equipment on a rental basis.

NICARAGUA, COSTA RICA, AND PANAMA

In northern Nicaragua, from the Honduras Border to the town of Sebaco, a distance of approximately 73 miles, the contract was negotiated with this same firm of Swinerton-McClure-Vinnell. The pioneer road passes via Canton, Condega, Esteli, and San Isidro to Sebaco, but does not follow the route of the Inter-American Highway between Esteli and Sebaco because of the greater distance involved. From Sebaco, the route had been previously improved to Managua and beyond to Diriamba. Most of this work had been done by the Nicaraguan Highway Department. This Republic also

owned considerable construction equipment, and a contract was entered into between it and the United States to construct that portion of the road in south Nicaragua from Diriamba to the Costa Rican border, a distance of approximately 65 miles.

Inspection of the existing road indicated that it would be difficult to improve through the mountainous terrain. Therefore, it was recommended that the pioneer road leave the route of the Inter-American Highway at Naranjo and pass via San Ramon, Esparta, Las Canas, Liberia, and La Cruz to the Nicaragua border. This route was finally approved by the Republic of Costa Rica and the Public Roads Administration as a portion of the Inter-American Highway. Construction on this section is being done by the U.S. Engineer Department on a hired-labor basis with government-owned equipment.

Construction Camp in Costa Rica Built Largely of Native Materials

From San Jose east and south to approximately nine miles beyond Cartago, the road has also been improved. The Public Roads Administration entered into a contract with the Ralph Mills Company for this portion of the work. From San Isidro to the Panama Border, a distance of approximately 91 miles, the route had never been surveyed and its exact location was difficult to determine. However, a contract was entered into with the Martin Wunderlich Company for the construction of this section of the road.

In Panama the portion of the highway not completed is the westerly end, a distance of some 30 miles from the Costa Rican Border to El Volcan, from which point there was a passable road to La Concepcion. It was necessary to construct an additional 15.5 miles between La Concepcion and David. These portions of the route were included in the contract with the Martin Wunderlich Company. From David to Panama City the route is complete and passable for a distance of 308 miles. However, there are many miles of narrow and rough road within these limits that should be reconditioned to make it passable for convoys.

For the construction of permanent bridges along the line of the Inter-American Highway, the Public Roads Administration entered into a contract with the Frederick Snare Corporation. This contract has now been enlarged to cover the construction of 17 permanent steel or

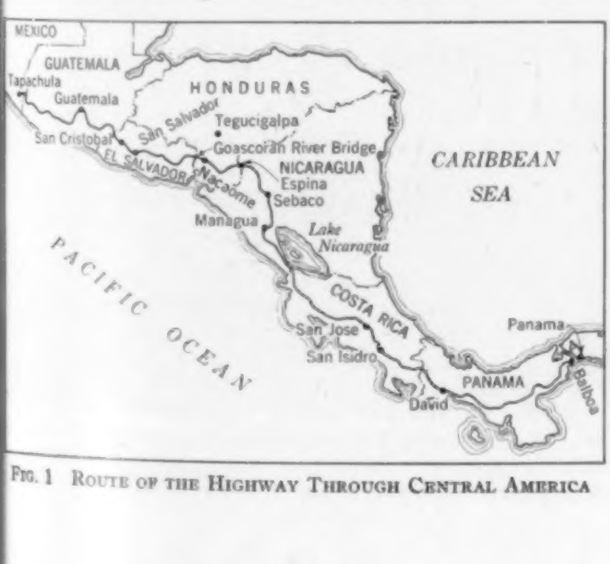


Fig. 1 Route of the Highway Through Central America

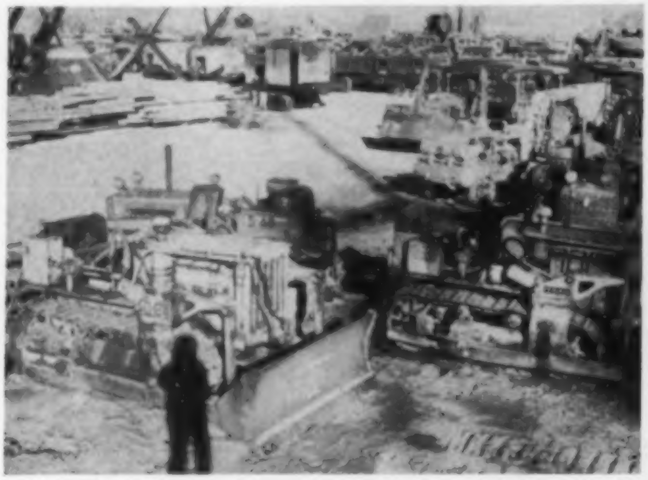
concrete bridges. Four are located in Nicaragua, ten in Costa Rica, two in Honduras, and one on the El Salvador–Honduras border. In addition, permanent concrete box culverts and corrugated-pipe culverts are being constructed along the regular alinement of the Inter-American Highway, the installation being done by the contractor working under the supervision of the Corps of Engineers. The cost of these permanent structures will be paid by the Public Roads Administration under the terms of Public Law No. 375.

Camps, Housing, and Sanitation

To provide living accommodations for American workers, the contractors constructed modern camps in many places. At some other locations, housing the personnel from the United States was accomplished by leasing and remodeling existing buildings. In Honduras, the camp at Nacaome is typical of those built for the contractor's forces while the Choluteca camp is located in the town, in buildings leased by the contractor and remodeled to provide suitable quarters and mess facilities. At San Marcos a new camp was constructed. In northern Nicaragua camps were built at Condega and Esteli. Near each camp existing airports were improved and extended to provide safe operation of planes used by contractor and Engineer Department personnel.

In northern Costa Rica, camps were built at La Cruz, Liberia, Las Canas, Guacimal, and Esparta. At San Ramon leased buildings were provided. In southern Costa Rica, camps were constructed at San Isidro, Buenos Aires, Paso Real, and Corredor. The latter is at the end of the access railroad from Golfito. In Panama there are newly constructed camps at El Volcan and Boqueron. In addition to these camps for American personnel, native camps were built at numerous locations for the use of clearing crews and native construction laborers. Prior to construction, survey camps had been built by the engineers, or premises were leased in towns and villages. When construction camps were completed, the survey camps were abandoned.

By authority of the Surgeon General, sufficient medical personnel were assigned to the project to care for industrial accidents, inoculations, treatment of tropical diseases, and other attention required by all American employees and Army officers. This personnel was under the general supervision of Lt. Col. Earle T. Norman and



EQUIPMENT WAS SHIPPED FROM THE UNITED STATES

consisted of officers of the Medical Corps, Dental Corps, and Sanitary Corps. Hospitals were provided at the camps in Nacaome and Esteli, as well as at area headquarters in Managua, Nicaragua. Also, hospitals were provided in Esparta, San Jose, San Isidro, and El Volcan. Medical officers were assigned to the hospitals and male nurses were provided at other camps where first-aid stations were maintained. Tropical diseases were well controlled and the number of cases of malaria was not excessive. Inspection was provided of all mess facilities, food, and water.

INTERNATIONAL RELATIONS

It must be realized that in all this work we were dealing with the Republics of Central America in which the Spanish language is spoken. Very few of our officers and men spoke the language. However, we found the governments of the Republics extremely cooperative and willing to be of assistance. Supplies and equipment were permitted to pass into the countries duty free, and special arrangements were granted in crossing the international boundaries. In fact, every effort was made by the governments of the various Republics to remove all obstacles that might prevent or delay the construction of this important highway. It must be realized that, for the most part, each of these countries was practically isolated from adjoining countries, so far as modern land transportation is concerned.

There have been civilizations in each country for more than four hundred years, and in each capital many cultured people are found. Transportation in the various Republics has passed from the ox-cart stage to that of the airplane practically without passing through railroad or highway stages. The opening of this Pan American Highway will have a marked economic effect on the future development of these countries. The people are eager and anxious to have friendly relations with the other Central American countries and are cooperating in the construction of this road. Our relations with the various Republics have served to further the relationships between the Republics and to cement a great friendship with the United States.

The natives of all classes have been exceedingly friendly and hospitable, and the native workers have been eager to do their part. When the unfinished gaps in southern Mexico have been completed, and the war has been won, automobiles will be again manufactured; rubber and gasoline will be available; and there will be great throngs of tourists from the United States traveling through Mexico and the Central American Republics all the way to Panama. Many of these will see opportunities in these countries. Without doubt, the Pan American Highway will have been the greatest single factor in accomplishing the economic change and in furthering the development of these Republics. This statement is made without minimizing the part played by the airplane in connection with construction of the Pan American Highway and with full credit to Pan American Airways and to the Transcontinental Airways Corporation of America system.

The entire project is supervised by Col. Edwin C. Kelton, Corps of Engineers, Director of the Pan American Highway, who maintains a Forward Echelon office in San Jose, Costa Rica. Major Murray N. Thompson, M. Am. Soc. C.E., is in charge of the San Jose Area office. The Managua Area office is in charge of Lt. Col. William W. Zass, M. Am. Soc. C.E., who has under his supervision Maj. M. C. Tobin, as Resident Officer in Guatemala, and Capt. George H. Barton, Assoc. M. Am. Soc. C.E., as Resident Officer in El Salvador. Captain Barton also takes care of negotiations with the officials of the Republic of Honduras. On the Director's staff are Lt. Col. E. E. Valentini, Special Assistant; Lt. Col. G. J. F. Carey, Chief of Operations; Lt. Col. Harold E. Spickard, M. Am. Soc. C.E., Chief of Engineering, and Maj. Frank S. McNamara, Deputy Director. Each Area Engineer also has a staff of officers.

Engineering Problems and Progress

By HAROLD E. SPICKARD, M. AM. SOC. C.E.

MAJOR, CORPS OF ENGINEERS, ARMY OF THE U.S.; CHIEF OF ENGINEERING, PAN AMERICAN HIGHWAY

FOR the length of the Pan American Highway a minimum width of 16 ft has been designed. This is to be surfaced with crushed stone or gravel to a minimum depth of 4 in. or a maximum of 8 in. The maximum ruling grade chosen was 7%, 10% being authorized in extremely difficult terrain, where the cost of a 7% grade would be excessive. The minimum curvature was 10°, but 20° curves were authorized for exceptional locations. As the road was planned to accommodate Army truck convoys, widened areas were provided at intervals of approximately 6 miles. These are 4,000 ft in length and constructed to a width of 22 ft. Temporary bridges have a roadway width of 15 ft and are designed for one lane of H-15 traffic.

As the plan for construction covered the grading of the roadway and surfacing with crushed stone or crushed gravel, the main problems concerned materials for drainage structures. Owing to the war, steel and cement were critical materials in the United States. For the same reason, sufficient ships were not available for transporting equipment and materials. A trip through the countries was made during the month of September covering as much of the route as was accessible, by jeep or on horses and mules. The rest of the line was flown over in planes

generally making use of the T.A. C.A. lines.

Such information as was available, and that obtained by inspection on the ground, indicated that it would not be feasible to erect timber bridges using driven pile bents. The watersheds of most of the rivers crossed are in the mountains, where floods rise rapidly and carry considerable debris at high velocities. Consideration was therefore given to the possibility of using other types of timber structures. In Costa Rica a survey was made of all existing lumber mills and it was determined that they were not able to handle timbers long enough to be suitable for bridge construction. Also there were no modern facilities for logging or for transporting logs of sufficient length to the existing mills. However, there were stands of timber in southern Costa Rica and western Panama which indicated that logs of sufficient size could be obtained near the line of the proposed highway. Plans to erect sawmills in locations where the timber was available, so that timber trusses could be constructed at the sites, were abandoned later because of lack of sufficient equipment for fabrication and the fact that no skilled native workmen were available.

Dense Panama Jungle Was Slashed Through for This Pioneer Route

TIMBER CLASSIFIED BY U. S. FOREST SERVICE

A party furnished by the U.S. Forest Service went into the field and classified the timber that was available near the line. Tests were made by the Forest Products Laboratory and basic working stresses recommended for design purposes. Further field investigation enabled the engineers to determine that sound straight trees were available which would furnish logs up to 80 ft in length. These logs could be hand-hewn by native laborers, who are very skillful at this type of work. Where foundations were suitable, footings of masonry were designed for intermediate piers, and the upper portion constructed of either masonry or timber. For the spans, hand-hewn logs were utilized up to a span of 62 ft, alternating logs, butt and top, and using fillers to furnish supports for decking. In northern Costa Rica the timber available was not suitable for large bridges. Materials for short spans were obtained locally.

Typical Roadway Replaced in Central America
Old Camino Real Near Rivas, Nicaragua

In Nicaragua the same conditions were found to exist, but there was a scarcity of suitable timber near the line of the highway. Honduras had considerable timber which could be obtained for spans up to 30 ft. In El Salvador the number of bridges was not large and it was planned to construct the substructures from stone or concrete and use timber decks. In Guatemala good timber was found in sufficient lengths to permit the design of timber trusses up to 120 ft in length. The Guatemalan Government, which had the contract for the construction of the road through Guatemala, was able to make a subcontract with a local mill operated by an American engineer. A number of timber trusses were fabricated at his plant, assembled, tested, dismantled, transported to the site, and erected by the fabricator.

LOCAL MATERIALS USED AS FAR AS POSSIBLE

Surfacing material was available for the entire project provided that crushers and sufficient trucks for hauling could be secured. There were two cement mills in operation in Central America—one in Guatemala City, which was able to supply the greater part of the cement required in the Republic of Guatemala, another in Nicaragua, south of Managua, between the highway and the Pacific Ocean. This mill furnished a portion of the cement required in the Republic of Nicaragua.

In Nicaragua there is a native material known as tuffa rock which is of volcanic origin and has been used as building stone for centuries. It had also been used for bridge abutments and piers. This stone, in place in the quarry, can be cut with hand tools to the approximate dimensions required for the work. After delivery at the site, a stone mason can easily trim it to fit the lines of the structure. Where deposits were available, this stone was used extensively for bridge abutments and piers. Upon weathering, the outside surface becomes harder. Inspection of bridge abutments and piers known to have been in existence over 25 years, showed practically no deterioration from weather or scour. The same stone in old buildings showed no sign of deterioration. Stone masons in Nicaragua turned out an excellent finished product with an appearance equal to that of any reinforced concrete structure

TIMBER BENTS FOR BRIDGE ON THE PIONEER ROAD IN EL SALVADOR

In the Republic of Guatemala there were also a large number of skilled stone masons. Where suitable rock deposits were available, stone masonry abutments and piers were used.

BRIDGES ACROSS MAJOR RIVERS

It had previously been determined that the Public Roads Administration would be responsible for the construction of bridges across major rivers in so far as it could obtain sufficient steel for the work. It was agreed that the P.R.A. would design and construct the bridge across the Goascoran River on the El Salvador–Honduras border, and two other major bridges in Honduras. It also planned to construct three steel bridges in northern Nicaragua, where the substructures had already been completed, and one steel bridge in southern Nicaragua. Later, additional steel was made available and the P.R.A. agreed to construct ten additional bridges in Costa Rica, or a total of 17 bridges. In addition, the P.R.A. had previously constructed several steel bridges which are being utilized along the route of the pioneer road.

As the inspection made in September indicated that sufficient bridge material was not available in the various countries, it was decided to purchase prefabricated truss spans for shipment to Honduras, Nicaragua, and northern Costa Rica. These bridges were designed as one-way structures with a 15-ft clear roadway and H-15 loading. This width was approved to provide for the movement of construction equipment and future military loads. The number of bridges of this type, fabricated and shipped from the United States, totaled as follows:

NUMBER	SPAN
40	50-ft
18	70-ft
6	75-ft
23	90-ft
6	100-ft

In addition to the prefabricated timber bridges, a survey was made of abandoned steel bridges throughout the United States which might be dismantled and reconditioned for shipment to Central America. This resulted in the purchase of eight such structures with spans of from 80 to 184 ft.

Standard designs were made for small bridges up to 30-ft span, utilizing local timber, also for unreinforced concrete arches up to 20-ft span, and for cut-stone masonry arches up to 20-ft span. It was considered that reinforcing steel would not be available for the substructures, so the timber and steel trusses were designed for mass concrete or cut-stone masonary piers and abutments. It was necessary to use local materials to the greatest extent possible to eliminate the need for shipping facilities and to prevent the use of critical materials from the United States.

Corrugated metal culverts were used in as many locations as possible to the extent they were available with the priority rating assigned the project. In some locations reinforced concrete boxes are being constructed along the alinement of the permanent Inter-American Highway, utilizing designs of the P.R.A. These permanent culverts are being built by contractors working under the supervision of the Corps of Engineers.

In general, the dry season begins about December 1 and continues until May or June, but the dry season of 1943 was longer in the four northern republics. In Costa Rica, it did not arrive until the end of January 1943, and by the first of May it was raining every day. Along some parts of the line in Costa Rica and Panama, an entire month never passed without rain, even during the dry season. In certain sections, during May and June, grading operations were impossible because the continuous rain soaked the earth to such an extent that it would not support tractors. Where corduroy was placed the load could not be distributed sufficiently and the timbers bowed in the middle and turned up at the ends. In many instances tractors were stuck in the mud, and sometimes mules were lost in the middle of the road.

In southern Costa Rica the location and construction of the road from El Empalme to San Isidro is being done by the Public Roads Administration, which has a contract with the Ralph E. Mills Company for the construction. This section of road runs through very difficult terrain and reaches high elevations. Soil conditions are very poor in many areas. Also at high elevations it rains throughout the year. It was difficult to make surveys in this section because the only means of travel was by airplane. It was necessary to fly in personnel and all supplies and equipment. The alinement generally ran through very heavy timber and clearing was required before most sections could be surveyed.

SURVEYING THE ROUTE THROUGH DENSE JUNGLE

In many areas the route to be surveyed ran through a dense growth of tropical jungle and it was necessary to employ a large number of native laborers to cut brush and clear the line in order to choose a location that could be constructed to the design standards. Also, the surveys were commenced during the rainy season and personnel and supplies were flown in. Along the proposed route, transportation from the camps to the work was on horseback, or when horses were not available, on foot. Practically all the American personnel of these survey parties had no experience working in tropical countries and many did not speak the Spanish language. It was not always possible to get supplies to the various camps before they ran out. In a few instances, they existed on foods bought

Formwork for a Reinforced Concrete Girder Bridge
Key Construction Men from the United States Are Supervising Native Labor on This Work

from the natives, supplemented by game. In rare instances, men resorted to eating monkeys and roots which the natives recommended as edible. The poem that follows was written by Ralph Zanchi, one of the surveyors who was in the jungle for five months and claims to have gone through various degrees of hardship. His partner was Don Oberg.

Every effort was made to furnish proper food and supplies to the survey camps, and the situation was not always in accordance with the poem. Kerosene refrigerators were purchased and transported to most of the camps not served by access roads. In many cases this was an extremely difficult job which required the clearing of a trail and the utilization of ox carts to deliver the iceboxes to the camps. However, the results were well worth while, as food could be kept better, the health of the men was guarded, and their morale was greatly improved.

Most of the original thirteen survey parties remained on the job until the work was completed and put up with the many hardships without complaint. The parties were recruited from Texas, Oregon, and California, and the men deserve a great deal of credit for a job well done.

Ballad of Two Tropical Surveyors

Twas down by the Sabalito
  Where the white-faced monkeys howl,
That me and a guy named Oberg
  Met a fate both rank and foul.

They stuck us back in a manaca shack
  And took our fifty bucks
Then said, "Survey these blinking hills
  You pair of dizzy clucks."

It was wet and cold, in this mess of mold,
  This tangle of tree and vine
And the moss hung rank, in festoons dank,
  While the rain dripped down our spine.

The little flies with the great big eyes,
  The bugs with a lust for blood,
Called everything that could carry a sting
  And ganged us where we stood.

They covered our pelts with burning welts,
  They woofed both me and Don,
But we stood'er fine and ran our line,
  For the Survey must go on.

With clothing damp, in a leaky camp
  We dined on rice and beans
And we learned to munch quinine for lunch
  While we dreamed of once loved scenes.

But listen mate, to the awful fate
  That hit these poor S.I's.
Whose only thought, both cold or hot,
  Was, run some more P.I.'s.

It wasn't the mold and it wasn't the cold
  And it wasn't the hungry bugs,
But sad to relate, a far worse fate
  O'ertook these two poor mugs.

They stuck us back in a manaca shack
  And here's what brings our groans,
For beans and rice and fleas and lice,
  They nick us fifty bones.

As the survey parties were equipped in Los Angeles, the instruments acquired were for English measure. The parties operated mainly in Honduras, Nicaragua, and Costa Rica. For the portions of the road to be improved in these countries, contracts had been negotiated with American firms, which used American skilled labor. For this reason the plans and designs were based on English measure. In the Republic of Guatemala the metric system was used as the Guatemala Highway Department had sufficient instruments for surveys and all their skilled labor was drawn from Guatemala. The same condition existed in the Republic of El Salvador, and on the road between the Rio Goascoran and Pavana in Honduras, where surveys and plans were based on the metric system. The metric system was also used on the south Nicaragua contract, as the engineering and construction in this section was done by the Nicaragua Highway Department. The English system was used throughout all of Costa Rica except for a short section in the south which had previously been surveyed by the Public Roads Administration. In Panama the metric system was used for the part that had been surveyed by the Panama Government, and the English system was used between El Hato and La Cuesta Piedra.

RAPID PROGRESS MADE

In order to show the progress being made, a newspaper article printed in *La Noticia*, Managua, Nicaragua, April 8, 1943, in Spanish, is here given in English.

"It Took 25 Hours from San José, Costa Rica, to Managua in a Jeep"

"An initial trip was made last week by Capt. Jack Yount, Capt. Rex J. Allan, and Engineer Fred R. Cline, members of the Corps of Engineers of the United States, who work on the Pan American Highway, from San José, Costa Rica, to Managua in 25 hours in a jeep over the new road. From Managua they proceeded to Condega, in the jeep, and back again to Managua."

Between April 29 and May 5, 1943, Colonel Kelton, accompanied by four other Americans, drove over the road from the Guatemalan–Mexican border to San José, Costa Rica, in 77 hours of travel time. This is the first trip ever made by automobile between these points, and covers a distance of approximately 1,600 km. Immediately after the completion of the trip, the rainy season commenced in earnest in the Republic of Costa Rica, and the dry-weather road became impassable.

The engineering design was at all times tempered by the availability of materials and equipment, and it was constantly realized that it would be necessary to use local materials to the utmost; also, that there would be a scarcity of equipment and that it would be necessary to utilize native labor. On the contracts with the various Republics, 100% of the labor on construction consisted of natives of the respective countries, and on the sections built by the American contractors, at least 90% of the laborers were natives.

Dock Construction in Iran

American Contractors Undertake Lend-Lease Project

By Donald B. McKinley

Project Engineer, Foley Brothers, Inc., Spencer, White and Prentis, Inc., New York, N.Y.

A SHORT time before Pearl Harbor, several American contractors, such as those with whom Mr. McKinley was associated, were requested by the War Department to undertake considerable construction in the Middle East. The preliminary details were speedily worked out, and by December 1941 a number of American engineers and construction superintendents were aboard ship bound for the Persian Gulf. Among this group was Mr. McKinley, engineer for construction of docking facilities in Iraq and Iran. In this paper he has related unusual circumstances that accompany work in that part of the world.

SOME time in October of 1941 the U.S. War Department called upon a group of American contractors to construct required facilities in the Middle East. Though it was realized that many unusual problems would be encountered in operating 12,000 miles from the home base, the obligations were accepted and the first steps were immediately started. It is needless to say that our entrance into the war increased the expected problems many fold.

An office was immediately established in New York for the purpose of making preliminary plans and obtaining men, equipment, and material based on available information. This equipment and material, as well as the skilled labor, were sent from the United States, while local sources overseas were depended upon to supply the common and semi-skilled trades as well as certain materials. The personnel and goods from this country were assembled and sent overseas as rapidly as possible in shipload lots, or in any space available on vessels going near the destined area. It is interesting to note that on one of the first ships were three Army officials who had originally been flying west to the Middle East but, stopped at Wake Island by bombings, were instead heading east by boat to the same destination.

From the time the first forces reached the site, every effort was bent towards starting construction, and as new men and equipment arrived their welcome consisted of an immediate introduction to their task. This was the most difficult period, for it was impossible to keep a proper balance between personnel and available plant. There was also a serious bottleneck in shipping, and our equipment, arriving from all quarters of the United States, overburdened the stevedoring forces at the port of debarkation, which prevented a progressive and orderly loading of ships and resulted in many lots being separated. Such conditions tended to increase the troubles at the receiving end. For example, a gas line split on one of four trucks sent on the first ship, tying up 25% of our rolling equipment until the next ship arrived with repair equipment aboard.

One of the first difficulties encountered was that of building up the general health of the native workmen so that they might perform a reasonable day's labor. As their poor physiques were caused mainly by a lack of sufficient food, which simply could not be obtained in the local bazaars in quantities to meet the demand, a daily ration was provided each man at cost. The ration consisted of one and a quarter pounds of flour, two ounces of sugar, and one-third ounce of tea. When it developed in many cases that the men had no means of turning the flour into bread, native bakeries were instituted, and the daily issue of flour was baked into their type of bread, a pancake-like loaf called a "schipattie" which tastes much like our cardboard. The fact that within a period of two or three months their physical improvement was very marked not only increased the efficiency of construction but also showed that the improvements we were making in the country were not confined to the structures erected.

Another interesting problem came up because the native monetary system had no coin between a copper, worth approximately a cent and a half, and a paper bill worth 15 cents. This affected our Army paymaster, as there were not enough of the coins minted to supply his needs. The problem was not solved until a brokerage system was introduced. Incidental amounts of each man's weekly allotment were allowed to accumulate and were then paid in a lump sum, thus eliminating the need for coppers.

On our arrival in the Middle East we moved immediately to the site of the proposed work and commenced setting up available equipment. For the port work, sufficient American labor was sent over to man pile drivers, but for all other operations gangs of natives worked with American timbermen, the former doing the bulk of the physical work. At the start a local native agent supplied the labor by contract. This was very unsatisfactory as his men went for long periods without pay and consequently could not eat. Next a bona-fide labor contractor was employed, though we later found that any citizen assumed himself and others capable of taking a contract for any service—no matter what his experience in that field! It was soon apparent that the contractor in question was no more satisfactory and since there was no alternative, we organized our own local labor department. Food was supplied in daily rations, and we gradually developed a group of men who were satisfied, comparatively well fed, and sufficiently skilled

A Dock Pressed Into Service Before Completion

at their particular simple operation to perform efficiently.

The young boys were much more apt than the older men and often developed into sub-foremen. A little fellow of fourteen had a bracing gang that needed very little attention, for he rarely missed a trick. He would strut up and down the falsework rattling orders to bearded old patriarchs four times his age.

Religious customs caused many lost man-hours, as the Mohammedans took time off for their prayers at least three times a day. Before we learned the proper ritual, Allah must have been highly pleased, for the workmen prayed every time they felt they needed a fifteen or twenty-minute rest.

One old man was of great value, in view of the fact that there was no replacement source for lost tools. At least once a week this ex-pearl-diver would visit the site, plug a set of shark teeth into his nostrils, and for about 60 cents an article would dive and recover all tools that had been dropped overboard.

Because of the serious scarcity of firewood on the desert, each native at quitting time would gather any scraps from sawdust to pile butts, and take them to his hovel. This was allowed until the natives developed the practice of inserting a hammer or file in the center of the bundle. This naturally could not be sanctioned.

A PROBLEM OF CLIMATE

The extreme heat caused serious interference with efficiency and production. At the start of the summer some of our men with experience on our western deserts expressed the belief that we could work through the heat of the day, but trials proved that it could not be done. The furnace-like blasts, plus the prevalent diseases, were too much for a normal physique, and yellow jaundice and heat prostrations became common among the men until a rest period was prescribed.

Fig. 1. Hydraulic Load Test Used as a Preliminary Check on Pile Capacity

Teak Logs Were Spliced and Driven as Piling

All equipment sent overseas was the finest the Army could obtain, and the difference between the old world and the new was very distinct in this respect. To see a modern motorboat towing three or four mahailyas, a type of craft used in the time of Christ, was almost a shock. The natives had depended on simple sails and manpower for so long that even a westerner expected nothing else. There were several locally built pile-drivers in the area manned by Indian troops of the British Army. To drive piles a drop hammer was used, which appeared to be a huge block of limestone riding on angles set between the leads and the weight. Piles were kept in place by Indians standing on each stage of the leads and holding a short length of rope. When the pile was spotted, the ropes were tossed around the pile and an upright, and then snubbed.

As long as ships were available, timbers and piling were sent from the United States, but as the full demand could not thus be met, piling and finally timbers were supplied by the British from India or Australia. It was a sorry sight to see beautiful teak and mahogany timbers sliding into the water as piles. The longest piling or timber was less than 40 ft, so that at least two, and in many cases three, pieces had to be spliced to make a single pile. Many of the logs were 20 to 30 in. in diameter, so that it was necessary to adz down two sides to a workable width. If the wood was not absolutely dry, it was just enough heavier than water for the piles to sink, which made handling considerably more difficult. All these factors tended to make the cost of splicing a pile much greater than the cost of driving it.

A quantity of lumber, supposedly 4 by 6 and 8 ft long, was shipped in for decking. Actually the apparently hand-sawed sticks ran from 3 by 3 to 5 by 7 and, when laid, resulted in a platform rough as a choppy sea. Sizing was out of the question because of the difficulty in cutting the hardwoods.

As is usual, the driving of the first pile was an event rating everyone's attention. The longest pile sent from America was selected—a Douglas fir timber 87 ft in length. The pile was to be driven in about 30 ft of water, with the cutoff 8 ft above mean tide. It is easy to picture the feelings of all concerned when the pile drove easily within 3 ft of cutoff and was capable of a resistance of only 4 to 5 blows to the foot with a Vulcan No. 1 hammer. Based on the Engineering News formula, this meant the pile was good for only 4 tons, and by no

EQUIPMENT BROUGHT FROM THE UNITED STATES CONTRASTED SHARPLY WITH NATIVE BOATS AND GARB

stretch of the imagination the 25 tons required. I can distinctly remember looking along the shore at the only type of tree in the area, the date palm, and wildly wondering how we could use its pithy trunk. The natives can subsist on the palm tree alone, using its leaves for warmth and shelter, its fruit for food, its fibers for clothing, and its sap for drink, but it was useless as a pile substitute or extension.

Since the soil ranged from a fine silty to a sandy material, we retested one pile twenty-four hours after driving and found that its resistance to driving had improved. A second hammer test five days after driving showed that a "freezing" action had taken place which caused an improvement in the carrying capacity of the pile to such a degree that it was safe under a load of 40 tons. To substantiate this, a hydraulic load test was made, as shown in Fig. 1. This scheme was utilized as there was no other available means of providing a reaction. It proved quite unsatisfactory, in that tidal and wave action caused a variation of the load by raising or lowering the stern of the barge. Thus it was impossible to apply a uniform load over a period of time. Also, it did not appear safe to run the load higher than 25 tons, which consequently did not allow for a safety factor.

Accepting this result as temporarily satisfactory under the conditions, the driving of piles was continued. However, as test piles placed throughout the length of the job disclosed no better subsoil conditions, and as many of the piles sent from the United States were less than 60 ft in length, a steel beam was borrowed from a bridge project at another camp 160 miles away and apparatus was installed for a more satisfactory pile test. A reaction was obtained by tying the beam down to two adjacent piles on each side of the one to be tested. Loads of from 5 to 40 tons were applied in increments of 5 tons, and the results plotted in the usual manner with settlement a function of the load applied, as shown in Fig. 2, which gives the results of loads applied to an 85-ft and a 65-ft pile. As can be seen, the latter length proved unsatisfactory. Since many of the piles sent from the United States were of this length or shorter, we secured a number of 20-ft lengths of concrete-lined steel pipe, which were fastened to the bottoms of the piling. Later when the teak piling was delivered, we switched to the much more satisfactory method of splicing on a length of timber. The added length was put on, not to reach a better stratum but to secure a more suitable penetration in the same stratum, for we found from the experience of other agencies that a better stratum could not be reached.

The engineers just referred to had used a pile made up of a solid steel column about 6 in. in diameter, which was literally screwed into the ground. This was a propeller-like affair from 4 to 7 ft long on the bottom of the shaft, providing the force that literally pulled the pile into the ground as the shaft was turned. Load tests made immediately after the shaft reached a depth of 125 ft proved the piles to have little more load-sustaining power than the same shaft after penetrating only 80 ft. The British finally adopted the same policy used by our organization of determining the bearing values by results of tests made several days after the pile was in location.

Because of the need for utmost speed of construction and the elementary skill of the native labor, the aim of the design was to make all connections and joints as simple as possible. This aim was complicated by the extreme length of free-standing pile and the limited height above the water line in which braces could be placed. To overcome this weakness, the top was braced stiffly in all directions while the structure as a whole was assumed to be flexible. The docking of several ships by inexperienced pilots proved this theory to be a fact, for the structure would give as much as 8 in. on contact.

No attempt could be made to treat the lumber used, but examination of the several timber structures in the area proved this unnecessary for a short period. The water was so thoroughly polluted that no respectable marine borers could live in it. In fact we found it a wise precaution to disinfect all Americans who fell into the water. The lining of the natives' stomachs appeared to be of cast iron, for they could even drink copiously from the river with no ill effects.

At the end of 1942, as planned, the project was turned over to the U.S. Army construction forces for completion, and the civilian personnel started the long trip home. The experience gained enhanced our appreciation of the facilities American engineers and constructors have. On the other hand, it is probable that the introduction of new methods and equipment into backward countries will in time tend to improve the living conditions of the peoples of those countries.

FIG. 2. CHART OF LOAD TEST ON TIMBER PILES

Navy Develops All-Timber Blimp Hangar

*II. Construction Procedure**

By Arsham Amirikian, M. Am. Soc. C.E.

Principal Engineer, Bureau of Yards and Docks, Navy Department, Washington, D.C.

SOARING timber arches span the Navy's recently constructed blimp hangars, 237 ft wide by 1,000 ft long. Unprecedented problems of erection were met in raising millions of board feet of lumber into position. Timber ring connectors were used throughout. Considerable doubt has been expressed as to whether such a structure could be built of wood without the use of these connectors. The design of these hangars was described by Mr. Amirikian in the October issue.

UNUSUAL in design details, a number of timber blimp docks have been completed for the Navy. These hangars are judged to be the greatest structures ever erected of timber. Structural timber was selected in order to conserve steel, and over 4,000 tons per hangar were saved as a result. Each hangar, exclusive of the doors, contains approximately 2,680,000 to 2,860,000 fbm of lumber. In the case of hangars with semidome doors, these amounts are augmented by an additional 638,000 fbm, while for those having flat sliding doors of composite design, the additional lumber is about 484,000 fbm.

FABRICATION AND TREATMENT FOR FIRE RESISTANCE

With the exception of the roof sheathing and some members of the secondary framing, the materials used throughout may be classified in the category of shop work, requiring elaborate preparation prior to erection. For this purpose, the facilities of structural timber fabricating shops were utilized. This procedure of planned shop fabrication, rather than on-the-job carpentry, was necessary not only to keep lumber waste to a minimum but also to assure speedy and accurate preparation, and economical construction.

Fabrication was planned and executed with the same care as that given to similar framing work in steel. The various operations consisted of the compilation of mill order lists, preparation of shop drawings, template work, cutting and punching of material, and check assembly.

After fabrication, all lumber was shipped to treatment plants to be made fire resistant. The required treatment, intended to give protection for the hangar against incendiary bombs as well as fire hazards from other sources, consisted of a vacuum process of salt impregnation conforming to specification No. 38b of the American Wood Preservers' Association.

A series of tests are now under way to determine the effect of this treatment on the strength of lumber. From the preliminary test results, it appears that a 4-lb salt injection per cubic foot of lumber will decrease fiber strength in static bending and in compression parallel to the grain by about 10%, compression perpendicular to the grain by about 3%, and increase end and radial hardness up to 25%.

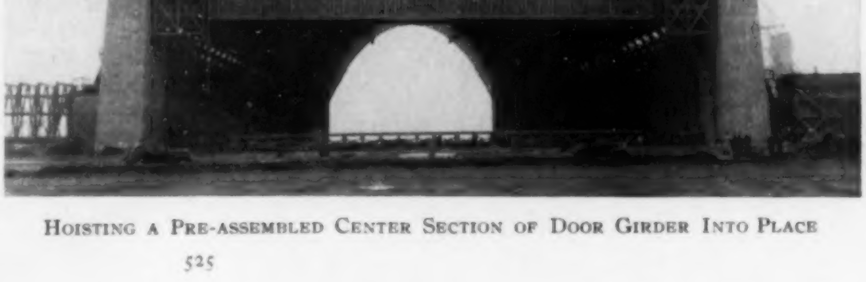
The rigid framing of the hangars and the door towers necessitated special care in the design as well as in the choice of type of foundations. The soil conditions at the various stations varied rather widely, the two extreme cases being a muddy silt of great depth and a firm sand overlying ledge rock at a comparatively shallow depth. Accordingly the type of foundation varied from an elaborate pile system to a simple spread footing.

Obviously, no satisfactory choice could be made without complete and reliable soil data upon which to predicate the design. To this end, immediately after the selection of each hangar site, a quick survey was made of all available soil data for determining the extent of the required additional information to be obtained from supplementary field tests and sampling. These consisted of:

1. Undisturbed soil samples, taken from 8 holes located at the four corners and at the third points of the side walls of each hangar, and carried down to a depth of 100 ft or to rock. The samples were tested and analyzed in the Bureau's Soil Testing Laboratory for obtaining the desired data on the physical characteristics of the soil, including shear strength, angle of friction, as well as the necessary information for computing the probable rate of settlement under loading.

2. Load bearing test, for determining a safe bearing load when using spread footings. For this purpose a test pit was dug to footing depth and a bearing plate, having a minimum dimension of 12 in. and simulating the shape of the footing, was placed at the bottom. The plate then was loaded with 1-ton or 2-ton load increments up to failure, and the corresponding deflections recorded by means of an Ames dial attachment. In addition, at every second or third increment, the plate was unloaded to measure the resulting recovery.

3. Pile tests, for determining the required depth of penetration to develop the bearing value used in design. The tests were generally made by driving a pile to the bearing value in accordance with dynamic formulas, then subjected statically to a load twice the computed



Hoisting a Pre-assembled Center Section of Door Girder Into Place

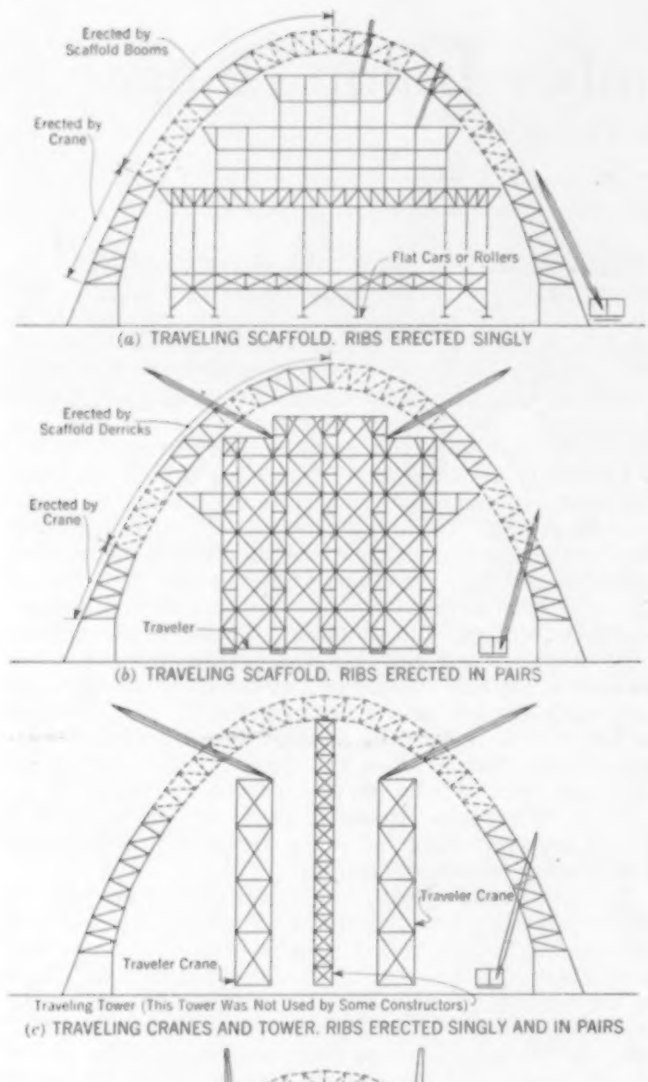


Fig. 1. Diagrammatic Outline of Erection Procedure Used on Timber Blimp Docks

bearing capacity. In case of failure under the latter loading, an additional pile was driven to an increased depth and the static overload test repeated.

Timber ribs are anchored to reinforced concrete abutment bents. This arrangement was used so that room for shops and offices could be provided without the interruption of numerous timber rib bracing members. Pile footings and spread footings were used for these bents, depending upon conditions.

In the spread footing arrangement, the two legs of the bent rest on two-step plain concrete pads, connected together with a tie. The maximum unit pressure under dead load at various localities varies from 2,500 to 3,500 lb per sq ft, while that with wind or snow, from 3,500 to 6,000 lb per sq ft.

In the pile-supported footing arrangement, two types of piles were used—cast-in-place concrete and timber. Timber piles were used at the station where the poorest soil conditions prevailed. In this case the outer and the inner footings were supported by 9 and 12 piles, respectively, 3 piles of each group being battered to resist an outward dead load and wind thrust of 22 and 7 kips, respectively, and an inward wind thrust of 54 kips. The piles were driven through 90 ft of silt to sand and carry a maximum load of 24 kips. As an additional precaution for this hangar, underground ties were provided between opposite abutments of the arches to insure against possible lateral displacements.

In both arrangements, an attempt was made to limit the maximum differential settlement between the two legs of each abutment bent to a computed value of 1 in. Because of this consideration, it was found necessary in some instances to use somewhat larger footings than would have been required by the soil bearing capacity.

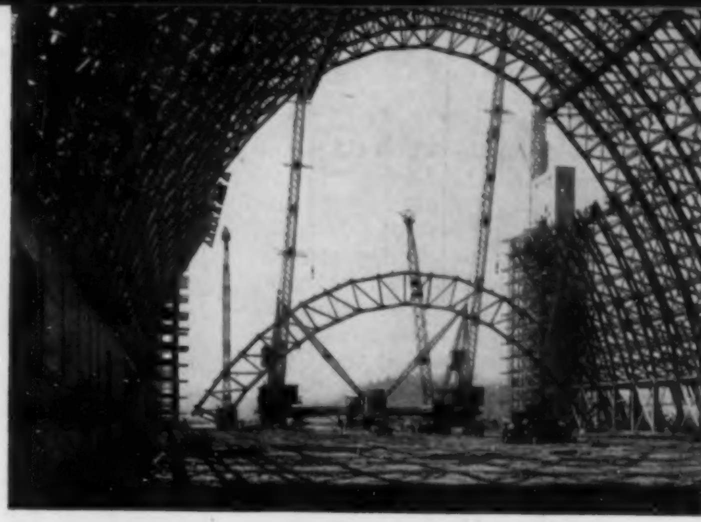
The total dead weight of the end door bent is about 6,000 kips, of which 450 kips constitute the weight of the box girder with its two cantilevers. Each tower accordingly imposes a concentric dead load of 3,000 kips on its foundation slab of plain concrete, varying in thickness at the various stations from 6 ft 6 in. to 9 ft, and in dimensions from 26 by 60 ft to 32 by 62 ft. As in the case of the arch bent footings, the foundation pad is supported either directly on soil or on piles. In the former case, the maximum unit pressure varies from 4,500 to 6,500 lb per sq ft, while in the latter arrangement, utilizing precast and cast-in-place concrete piles, the maximum pile loading is about 60 kips. The tracks for the flat sliding doors, as well as for the semidome door, have the so-called ballasted-type foundation generally used in railroad construction. The ballast was placed in layers and grouted and rolled to provide a water seal.

Erection Methods Varied

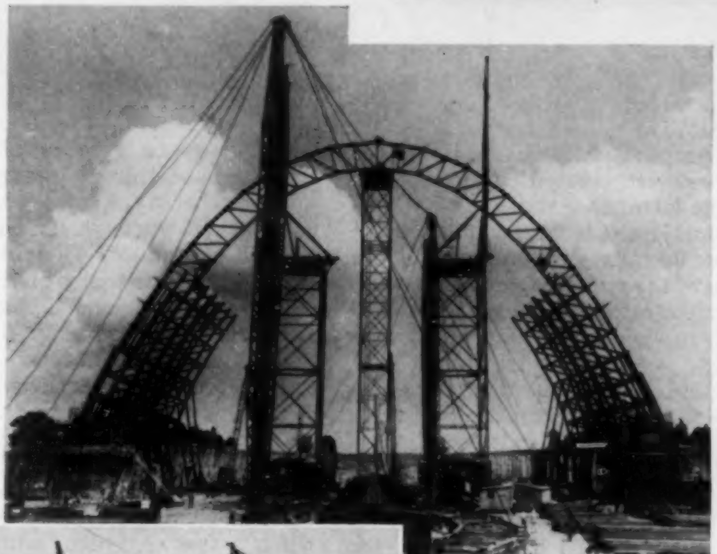
Generally a standard design or set of plans is supplemented by a standard procedure of construction. While such a procedure could have been developed for the erection of the hangars at the various stations, it was felt that the desired end, namely, economy and speed of construction, could best be accomplished by letting each contractor plan his own method of erection. This conclusion was based primarily on the consideration that, since several hangars were to be erected simultaneously at various sites by different contractors whose facilities and equipment differed widely, the so-called standard procedure would lack sufficient flexibility and might result in hardships to some erectors.

Because there was no precedent for such timber construction, erections were planned without the benefit of previous experience. To partially overcome this handicap, extensive use was made of small-scale models for

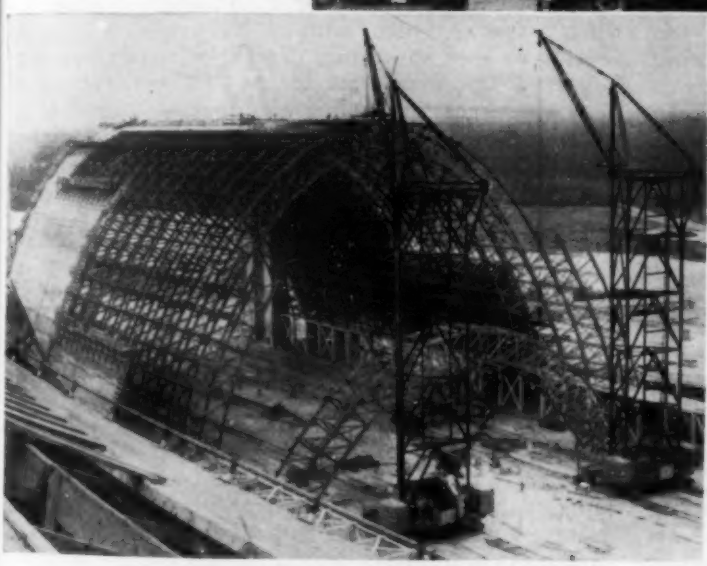
ERECTION OF ARCH CROWN SEGMENT BY GIN POLES MOUNTED ON A TRAVELING SCAFFOLD



ERECTION OF A SINGLE-RIB ARCH SEGMENT, WEIGHING 4 TONS, BY MEANS OF TRAVELING DERRICKS



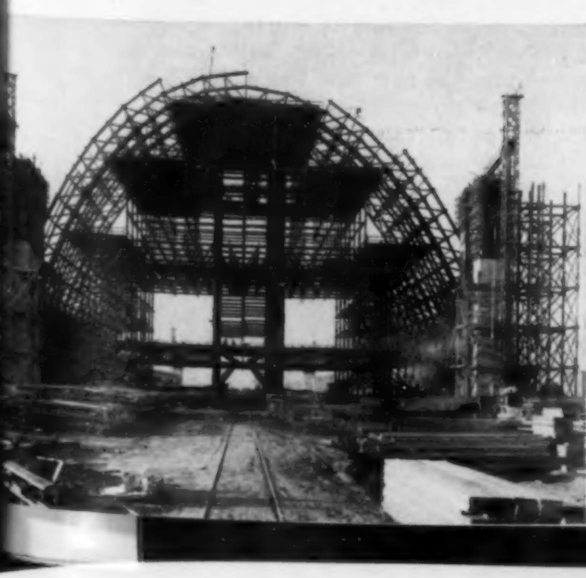
SINGLE-RIB ERECTION BY MEANS OF TRAVELING TOWER CRANES WITH CENTERING FOR CROWN JOINT SPLICE

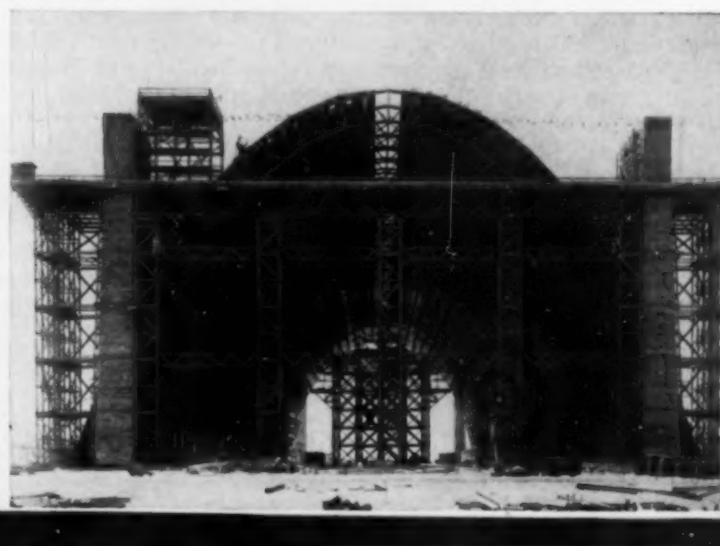


(LEFT) ERECTION OF A DOUBLE-RIB ARCH SEGMENT, WEIGHING 21 TONS, BY TRAVELING TOWER CRANES

(BELOW LEFT) VIEW OF ERECTION BY MEANS OF A TRAVELING SCAFFOLD

(BELOW RIGHT) SCAFFOLD FOR ASSEMBLED-IN-PLACE DOOR GIRDER; TRAVELING SCAFFOLD IN BACKGROUND





simulating the various steps of erection procedure. These studies covered not only the extent of field assemblies, but also the equipment and the manner of erection, truckage, and yard layout. At certain stations, planning was somewhat simplified by the fact that there was available at the site erection equipment used on previous construction work.

The main device for erection of the hangar roof framing consisted of a traveling scaffold or of towers supplemented by ground cranes. Some of the erection procedures used at various sites are shown diagrammatically in Fig. 1, and illustrated in the accompanying photographs. In both scaffold and tower methods, the arches were erected either in single or double rib units; in the latter case the assembly consisted of panels from two adjacent arches, connected together with purlin trusses and rafters to form a box-truss section. The lower panels of the arch ribs were erected by means of ground derricks, the assemblies being secured to the tops of the concrete bents and retained in position as cantilever truss segments.

SEMIDOME DOOR WITH COMPLETED FRAMING ON SCAFFOLD

The size of the erection assemblies was obviously governed by the capacity and reach of the lifting derricks. Where a scaffold was used, utilizing relatively small derricks, the number of assembly units per arch or per pair of ribs varied from 7 to 10, with lifting weights of 4 to 6 kips; while with traveler cranes or derricks, the number of assembly segments varied from 3 to 5, the corresponding heaviest and lightest lifting weights being 43 and 8 kips, respectively. The heaviest erection unit was the crown or center piece in a three-unit double-rib assembly arrangement. This 20-panel segment, consisting of two ribs, purlins, purlin trusses, and bottom-chord bracing, weighs approximately 21 tons. A similar piece in a single-rib assembly arrangement weighs about 7 tons. For the erection of a four-unit assembly, an additional traveling tower was utilized for splicing the crown joint. When a traveling scaffold was used for erection, the upper arch segments were assembled on the scaffold platforms and placed in position by means of gin-pole derricks.

Erection of the remainder of the roof framing followed closely the erection of the arches in the following order: purlin trusses, purlins, bottom and top chord bracings, rafters, and sheathing. The transverse splice lines of the sheathing were broken by the use of random lengths, and placing was accomplished by means of an adjustable platform anchored to the completed parts of the planking.

To provide enclosure for the huge openings at the ends of the hangars, two types of doors were used. Both types are entirely self-supporting. Flat sliding doors similar to those generally used on airplane hangars were hung on a bent separated from the arch framing. These bents are composed of an overhead box girder supported on two cellular concrete towers. There were no unusual problems involved in the construction of the concrete towers. Standard form work was utilized, after due consideration had been given to the use of sliding forms.

The center span of the overhead box girder was built in position on a scaffold, and the two cantilever spans were assembled either on scaffolds or on the ground, then hoisted into place. A circular or parabolic camber of $2^1/_2$ in. was provided for the center span. At one station, because erection equipment was available, the center span as well as the two cantilevers were built on the ground and lifted into position by a system of counterweights. This erection sequence necessitated a revision in the design of the center span to render it a simply supported girder. Consequently, heavier chord sections were substituted for the originally lighter sections, and the camber was increased to $4^1/_2$ in.

In general, the main framing of the door leaves was assembled on the ground on skids, then lifted to a vertical position on top of the track rails, and fitted into the upper grooves of the guides. Joists, wood grits, and sheathing were then installed in place.

The other type of enclosure is a semidome door mounted on tracks at the hangar ends. For the erection of each such door, a circular scaffold was built. This scaffold, with its many platforms and derricks, served as centering for the radial ribs and facilitated the placing of the rest of the framing. By this device, it was possible to erect the entire structure in small segments and maintain theoretical dimensions during all stages of construction, thus preventing free deflections and the resulting deformations in the framing prior to completion.

For erection stability, a high timber arch is at a disadvantage in comparison with a similar steel framing. This is particularly true at early stages of assembly, when a few arch ribs, without the benefit of complete bracing or roof sheathing, present relatively large surfaces to longitudinal wind forces. To overcome this inherent weakness in framing, guy bracings in various arrangements were utilized during construction. At certain stations, partial use was made of derricks or an erection tower to supplement guying. In addition, an effort was made to keep the lag between the completed arches and the placing of the remainder of the roof framing and the sheathing to a minimum.

Unusually high wind pressures were experienced during construction of the majority of the hangars, velocities of approximately 60, 70, and 90 miles per hour being recorded at three stations. At the second site, a partial collapse of the then few erected arches occurred as a result of inadequate guying. The partially completed framings at the other two sites, however, withstood the wind impact, in both transverse and longitudinal directions, without any apparent sign of injury.

In general, the framing was assembled and erected by carpenters and riggers, but at certain stations structural steel workers were also employed. In the early stages of construction, the rate of erection was about $1^1/_3$ arch bays per day. In later stages, however, with the benefit of experience, the rate rose to about $2^3/_4$ bays per day.

The hangar projects constitute a part of a huge Naval Public Works program administered under the Bureau of Yards and Docks. Rear Admiral Ben Moreell (CEC), U.S.N., Hon. M. Am. Soc. C.E., is chief of the Bureau; Capt. W. H. Smith (CEC), U.S.N., Director of Planning and Design Department; and Comdr. E. H. Praeger (CEC), U.S.N.R., Design Manager (both M. Am. Soc. C.E.). The principal designs were prepared under the writer's supervision by B. G. Anderson, E. G. Odley, and E. R. Slade of the Bureau's Designing Engineers Staff.

Concrete Portion of Building Completed Before Steel Erection at Oklahoma City Modification Plant

Two Modification Centers Requested—Immediately

Tulsa and Oklahoma City Are Scenes of Construction Miracles Supervised by Corps of Engineers

By Thomas M. Robins, M. Am. Soc. C.E.

Major General, U.S. Army, Assistant Chief, Corps of Engineers

Construction of the first unit in the Tulsa Aircraft Assembly Plant was completed in less than 13 weeks. Operating under pressure of immediate need for such facilities, contractors used every known trick of the trade to establish a record for the completion of this $4^1/_2$-million-dollar plant. Cooperation in the delivery of material and equipment was maintained through the efforts of the Tulsa District, Corps of Engineers. In this article, General Robins shows the drama "of people and things" that accompanies wartime construction.

There seems to be a prevailing notion among those outside the construction industry that reports of construction projects are mere documentary accounts of routine methods and procedures. Someone explained this belief recently by saying that all such achievement is the result of hard, unromantic, driving work that just does not become dramatic in the eyes of the public.

Such conclusions fail to take into account the human element involved in building something—the foresight and judgment demanded for trigger-quick decisions; the planning, organization ability, and drive called for to meet discouraging schedules; and, especially in the case of most of the war installations, the cooperation, spirit, and patriotic efforts of thousands of workers, gathered from all walks of life, coming from different geographical areas, and representing practically every phase of human interest—all united in a resolute purpose to help defeat the Axis by seeing to it that in the construction effort there will be enough and on time.

The annals of the construction industry will include no more vivid chapters than those written during the war construction program. Into the some 2,000 major projects and several thousand smaller jobs that make up this program are cram-packed not only dramatic stories of people and things but an element of comedy and some tragedy as well. Representative is the record established recently through the District Engineer's Office at Tulsa, Okla., on modification center projects at Tulsa and Oklahoma City.

The real significance of this achievement, however, comes out only when the specific scene is thrown upon the backdrop of the broader situation which made it necessary to have modification centers and to work against impossible deadlines to get them in operation.

"Speed" is probably the best one-word description of World War No. II. From the first unexpected blasts of blitzkrieg tactics by the German armies, the emphasis has been upon sudden and surprise attacks—upon the ability to reach an objective first and with greater power than the enemy. Japan used the same elements of surprise and speed in the treacherous attack on Pearl Harbor and immediately thereafter upon other objectives in the Pacific.

Through years of advance preparation, planning, and production, the Axis countries expected to rush through to victory before the Democracies could get under way. Their time-table was thrown out of schedule. Backed by a history of surprising accomplishments, this country, working hand in hand with the other Allied powers, accepted the challenge of getting enough and on time. Now the initiative has been wrested from the enemy, and the war is being brought home to him at times and upon battlefields of our own choosing.

Our peace-loving nation, busy with efforts to build for progress, swung abruptly to war production with a speed that permitted us to accomplish in two short years what the dictator-driven countries took seven long, back-breaking years to do.

Construction Industry Adaptable

In such a swing-over, construction was the key. Our entire record in this war has been made possible in many important respects only through the amazing plasticity

STEEL ROOF TRUSSES ERECTED ON FREE-STANDING COLUMNS—TULSA MODIFICATION PLANT

of the construction industry—the ability to make adjustments to meet new situations. The freemen of this country shifted their equipment and their skills so aptly and so quickly that construction schedules were broken and broken again. There has been a constant challenge to do the things that hitherto had been considered impossible. This was especially true in work on the modification centers in Oklahoma.

Much of this war is being fought in a new battlefield, scarcely used even in the first World War—the limitless battlefield of the air. As Brig. Gen. Stuart C. Godfrey, M. Am. Soc. C.E., Air Engineer, Army Air Forces, has pointed out, the power of the Air Forces is delivered by a propeller with three delicately balanced blades. The first blade is the aircraft, the second blade is the airmen, and the third blade the airdromes.

The Corps of Engineers and the construction industry have played a major role in developing and maintaining the delicate balance of these blades. Great, modern aircraft plants were constructed, and from these plants are now coming all types of military aircraft in numbers that cast an ever-darkening shadow over the hopes of the Axis. Air Force troops are training at huge installations completed on impossible schedules. Hundreds of airdromes have been built, at home and abroad, to add a historic chapter to the annals of American engineering.

Another feature of the program of the Air Forces has been the construction of modification centers—places where all the special equipment for various climates and various governments is installed in new aircraft. These modification centers allow the assembly lines of the aircraft plants to concentrate on mass production of standard models. The planes, however, must serve in various parts of the world, under widely varying climatic and operating conditions—in the tropics, in desert areas, in the Arctic. Many of them are required to make long over-water flights.

Before the finished planes are placed in service, therefore, operational changes are effected at modification centers, making the planes suitable for special missions. These changes may include, for instance, the placing of different guns, extra gas tanks for long flights, an extra gun turret, and any other modifications which may be required or desired by our Allies. The Russians, for example, insist upon certain changes in equipment in line with the training and experience of their men and the requirements of their type of warfare. The British need other changes. All such changes are made in modification centers, which also permit the adoption of latest developments without interference with established assembly lines.

TULSA PLANT ANTICIPATED

Upon being notified that construction directives were likely to be issued for modification center No. 16, to be built at Tulsa, and modification center No. 17 at Oklahoma City, and that it was imperative that both jobs be completed in the shortest possible time, the Tulsa District Office made a thorough investigation of the possible systems of construction to determine which, under existing circumstances, would result in the greatest speed.

As a preference had been expressed for a concrete structure, both ZD and rigid-frame concrete were investigated. It was decided that both of these methods, because of difficulties in forming and other factors, would take too long. Wood trusses were also investigated and discarded because of scarcity of structural lumber. From these investigations, Col. F. J. Wilson, M. Am. Soc. C.E., District Engineer, decided to erect the buildings with a reinforced-concrete center section and a steel trussed roof on concrete columns for the hangar section. Major Earl A. Cornell was named area engineer for center No. 17, and Capt. John R. Soderberg for No. 16.

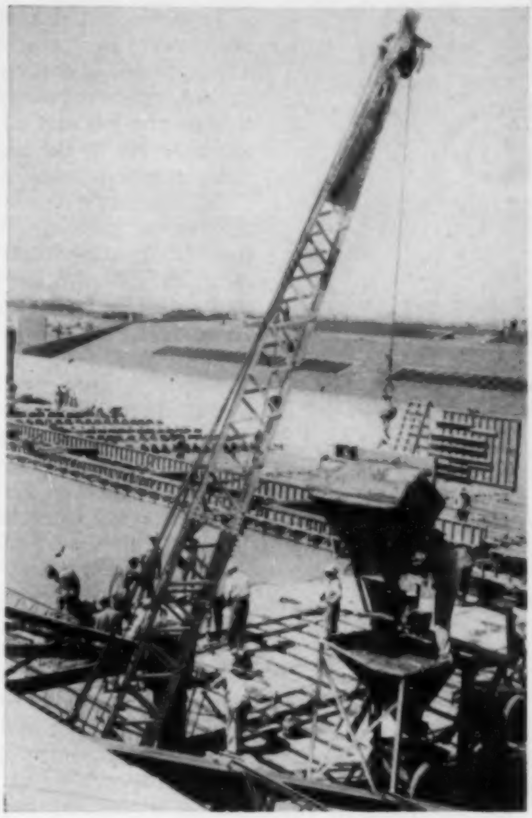
After these decisions had been made, the following plan of action was evolved:

1. The Tulsa District Office would produce drawings for site grading. Topography was to be done in connection with the site investigations, and this could start almost immediately.

2. An architect-engineer would be retained for each job to produce all other drawings, designs, and so forth.

3. Structural steel design for both jobs would be identical and reinforced concrete design essentially the same.

TRENCHING AND BACK-HOE MACHINES EXCAVATED FOR COLUMN FOOTINGS



Concrete Was Elevated by Dump Buckets and Distributed by Buggies from a Hopper

4. The Tulsa Engineer District would purchase and furnish to the constructors all materials such as structural steel, pipe, heating equipment, reinforcing steel; special equipment, such as water heaters, air compressors, chlorinators, cafeteria equipment, ventilating fans, and so forth, where fabricating time could overlap bidding time so that the material could be in fabrication before general contracts were awarded.

The directive was received for modification center No. 17 on April 23, 1943, and for modification center No. 16 on the following day. Work started on grading plans immediately. Architect-engineers were called in, and on the evening of April 24 contracts were let for Architect-Engineer Title I Service to J. Gordon Turnbull and Sverdrup and Parcel, of St. Louis, for modification center No. 16 and to the Austin Company, of Cleveland, for modification center No. 17.

Contract Procedure Simplified

The structural designers of both firms were immediately called into conference, and on April 28 contracts were let for the furnishing and fabricating of structural steel. As quickly as material lists and specifications could be furnished by the designers, other materials were purchased by the Tulsa District Office. The larger of the material contracts were let as follows:

Modification Center No. 16

May 1, 1943.	concrete pipe
May 3, 1943.	cast-iron pipe
May 5, 1943.	steel joists
May 7, 1943.	heating equipment
May 12, 1943.	cement

Modification Center No. 17

May 4, 1943.	concrete pipe
May 4, 1943.	cast-iron pipe
May 5, 1943.	steel joists
May 7, 1943.	heating equipment
May 12, 1943.	cement

Offers were solicited for the grading of the site for the Tulsa plant on April 23, and a contract was awarded seven days later. Site grading for the Oklahoma City plant was opened for offers on May 3, and award was made four days later. Grading operations were arranged to clear and establish finish grades on the space occupied by the buildings first, so that the operations of the grading contractor and the building contractor could telescope.

Offers were solicited for the construction of the Tulsa plant on May 18, and on May 25 a contract was awarded to the Corbetta Construction Company, Inc., of New York. For the construction of the Oklahoma City center, offers were solicited on May 17, and a contract was awarded on May 25 to the Charles M. Dunning Construction Company, of Oklahoma City.

Although the foregoing information is somewhat documentary, it reveals the measures taken by the Tulsa District to cut time wherever possible—an urgent requirement if the completion dates were to be met.

Progress on both jobs proceeded at about the same rate, neither job getting more than a few days ahead of the other. That is one reason why this report must necessarily deal with both plants. The methods of attack used by the two contractors on the erection of the buildings, however, were quite different. The Corbetta Company chose to erect free-standing concrete columns and to start the roof steel almost immediately, while the Dunning Company chose to erect the concrete center portion first, letting the roof steel wait until that part of the work was complete. Both contractors made constant use of high early strength cement to allow rapid loading of the concrete structure and early removal of forms.

At each plant, there are two principal buildings, each 420 by 600 ft. They are made up of twin hangar-type structures 160 by 600 ft, with 100 by 600-ft two-story lean-to sections between them. The permanent-type buildings, which are of concrete and steel, are fireproof. The over-all height of the hangar portions of the buildings is 49 ft.

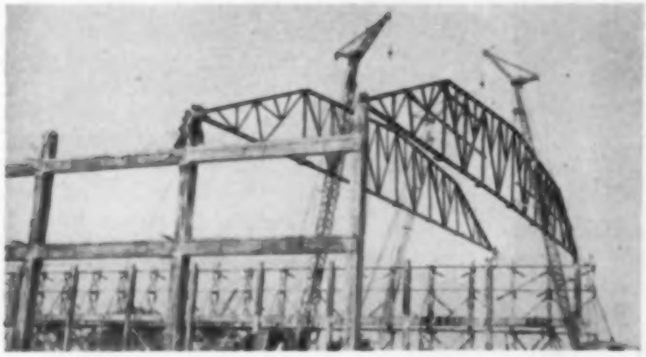
It was less than 13 weeks from the date the War Department directive was issued to the Tulsa District Office until the time the first unit of the $4,500,000 modification center annex to the gigantic Tulsa Aircraft Assembly plant was turned over for occupancy to the Douglas Aircraft Company on August 1, 1943. The other unit was turned over on September 1, and a $250,000 drop-hammer building in connection with the project has been started and is scheduled for completion by November 20, 1943.

Such construction schedules were not established merely to satisfy the whim of someone in high authority to set new records. Our forces overseas were calling for planes equipped for their particular needs. Our Allies were waiting for planes that could be thrown into action upon reaching their destination. Invasion was imminent, and a protective umbrella of planes had to be provided. Furthermore, the Allied strategy called for round-the-clock bombing. Thus a steady supply of planes ready for specific uses was essential.

Schedules Accelerated to a Remarkable Degree by All Concerned

The District Engineer's Office recognized the urgency. The contractors were willing to accept the challenge for speed. The workmen caught the spirit, realizing the importance of their fight against time just as realistically as if they had been engaged in invasion themselves.

Plans and specifications that normally require from 45 to 60 days were ready in 19 days. Instead of the usual 12 weeks required to start steel through a mill, the steel for this work was being rolled 9 days after the directive was received. The entire job, which would have



STEEL TRUSSES BEING ERECTED ON FREE-STANDING COLUMNS BY CONTRACTOR AT THE TULSA PLANT

taken from 10 to 12 months under normal schedules of peacetime construction, was ready to serve its purpose in less than 100 days.

It cannot be said that "the breaks" favored completion of the work on time. During the construction period, Oklahoma had a month of the greatest rainfall on record. When the time came to let the general contracts, Tulsa was practically isolated by the record floods that plagued the Midwest in the spring of 1943. Contractors had to fly their crews into the city to prepare their bids on the grounds.

The problem of getting the steel was solved when it was discovered that a plant in St. Louis could start fabrication immediately. The delivery of key equipment was not left to chance. Representatives of the District Engineer's Office were sent to ride the rails with the equipment to see that there was no unnecessary delay. The pressure of the job was translated by the contractors into terms their employees could understand. When a squadron of planes landed on July 31, so that the operating crews could follow "their" plane through the plant before leaving with it for a theater of operation, it brought the war close to home to the workers and made every man on the job feel that he had won a personal victory.

This indicates the human drama incorporated in a major construction job. But there is still more to the story—additional methods used to speed up the work.

COORDINATION OF WORKMEN EFFECTED

For example, mobilization and actual construction work on the Oklahoma City job were concentrated on the first unit for the first two weeks in order to get it under full construction at the earliest possible date. At the beginning of the third week, the construction organization for the second unit was formed by taking experienced crews from the first unit and supplementing them with new men to make possible a more rapid start on the second unit.

Construction operations were begun in the center of the buildings and prosecuted with two crews, working both ways from the center to the ends. Trenching machines were used to excavate the perimeter to full depth for the footings and furnace rooms, leaving only the excavation of the center material overlooked by the trenching machines for clamshells and hand labor.

Work was prosecuted on both units simultaneously, except that the second unit was approximately two weeks behind the first. While this procedure did not permit the maximum re-use of concrete forms, it did expedite construction by making it possible to use experienced crews on the second unit. The "bugs" that had been removed in constructing the first unit were avoided in the second.

Truck-mounted mobile concrete mixers with adjustable towers were used for mixing and delivering concrete. These portable concrete mixers, with hoisting tower attached, made it possible to set up the mixer at any location on the job and adjust the hoisting tower for delivering concrete to the highest point necessary in the structures in exceptionally short time.

All specialty trades subcontractors were organized. As far as possible they prefabricated such items as metallic heating ducts, wooden wire raceways for the electrical distribution system, roughing-in for plumbing, and so forth. Thus when the buildings were ready for these features, it was possible to install them without delay.

Concrete floors were placed in lanes running the full length of the buildings, instead of checkerboard fashion. Paving mixers were used to mix and place concrete for floors, while the concrete for paved aprons and taxiways was mixed and placed with two pavers working on one lane. Paving operations were planned in such manner that the lanes were placed from the outside limits of the aprons, surrounding the structures, toward the buildings. This permitted the paving operations to start earlier and to offer the least interference to structural operations.

Eight complete construction organizations—two on each building, with two 8-hour shifts on each building per day—were used to speed up the work. The organization made full use of daylight hours, working from 5 a.m. to 9 p.m. Because of a shortage of common labor, the contractor was never able to organize a third complete shift. However, separate smaller organizations were formed to construct small miscellaneous structures. An extensive four-track temporary railroad yard was constructed at the site in order to expedite the handling of carload shipments of materials.

Special attention was given by both the Area Engineer and the contractor to expediting the shipment of materials and equipment. Full information was made available to all those interested. Daily meetings attended by representatives of the prime contractor, the subcontractors, and the Area Engineer were held to enable all concerned to keep fully informed on current developments and to iron out any problems that might delay the work.

Through the use of such methods—some old, some new—it has been possible for the construction industry, working hand in hand with the Corps of Engineers, to handle the war construction program. Under the pressure of wartime requirements, we have learned many things that will continue to be helpful in the construction industry during the years of peace that lie ahead.

STEEL PAN FORMS USED FOR FLOOR SLABS

Construction Plant for Fontana Project

I. Aggregate and Cement Plants

By R. E. Martin

Construction Plant Job Engineer, Tennessee Valley Authority, Knoxville, Tenn.

In the race against time to complete Fontana Dam as an emergency war project, more than 9,000 cu yd of concrete have been placed in a single day. The construction plant which has made this possible combines the best features of several completed projects with a few new "wrinkles" added. Mr. Martin describes arrangement and selection of equipment for this plant. In Part II, which will appear in the December issue, he will discuss the concrete batching and mixing plant and the construction trestles. The design of this project was discussed in the July 1943 issue, by Calvin V. Davis and Adolph A. Meyer.

In January 1942, the Fontana Project was authorized by Congress as an essential emergency war project, which necessitated its being built in the shortest possible time. No major construction equipment was available for transfer from other TVA projects, and this had to be taken into consideration in setting up the construction schedule. Preliminary inquiries indicated that a year would be required for the purchase, delivery, and installation of the equipment making up the main features of the construction plant. Closure was then, of necessity, scheduled for the spring of 1944. Approximately 2,800,000 cu yd of concrete is contained in the main dam, spillway and auxiliary structures. The construction schedule called for the placing of concrete at the rate of 200,000 cu yd a month, or 8,000 a day.

One of the first problems requiring immediate attention concerned the source of concrete aggregates. Considerable time could be saved were it possible to secure this material from a commercial source, as the procurement of crushing and screening equipment was a point of major concern. No commercial rock producing concerns or natural sources of sand or gravel were available within any reasonable distance. Shipping aggregate in by rail for any appreciable distance would have been a tremendous drain on existing railroad facilities, as approximately 15,000 tons of processed aggregate would be required daily, amounting to about 300 standard hopper-bottom cars, not allowing for the cars that would be in transit or those being loaded at the other end of the terminal. A more serious consideration was that the rough and mountainous terrain at the dam site did not lend itself to providing either sufficient railhead or adequate storage facilities to assure uninterrupted concreting, should some delays be experienced in the train schedules.

QUARRY OPENED

After some exploration, it was decided to develop a quarry some 5,000 ft downstream from the dam site and near the right bank of the Little Tennessee River. Tests indicated that a satisfactory product in sufficient quantity was available and could be developed without undue difficulties or delays. The general plan of all the construction plant facilities in the immediate area of the dam site appears in Fig. 1.

The rugged mountain topography, with considerable topographic relief, dictated the use of belt conveyors for the transportation of aggregate through the various stages of processing, as well as for transporting concrete out to the three construction trestles. In all, there are more than two miles of belt conveyors, varying from 42-in. to 24-in. Timber construction was employed wherever feasible, in an effort to avoid the use of steel, which was difficult to procure.

There was considerable overburden at the quarry site, and this was handled with shovels and trucks. Seven electrically powered, crawler-mounted, blast-hole drills are used for the primary drilling of 9-in. holes. Approximately a 30-ft burden is being obtained with holes drilled at 25-ft centers. The present working base of the quarry is about 210 ft high and about 1,000 ft long, with the quarry floor at El. 1330. Nitramon blasting material, grade A, sizes 8 by 21 and 7 by 24, in containers, is used for primary blasting. The yield is about three tons of rock per pound of explosives. Some secondary drilling is required, for which jackhammers are used. On this job we are experimenting with the drill hole pattern, as well as with the method of loading and shooting, in an effort to reduce to a minimum the amount of secondary drilling.

PRIMARY CRUSHERS

Rock is loaded, by five 3-yd electric shovels, into 12-yd dump trucks, which carry the rock to the primary crushers, consisting of two 42-in. gyratory crushers with a setting of about $4^3/_4$ in. These crushers are each driven by a 250-hp motor, and are placed side by side, with truck access from two sides. A total of 536 truck loads of rock, averaging $13^1/_2$ tons, have been dumped into the two crushers in one 8-hr shift, for a crusher capacity of approximately 450 tons per hr.

Aggregate Storage Stackers

A Tunnel Beneath the Pile Provides for Moving Aggregate to Mixing Plant

AGGREGATE PLANT AT FONTANA PROJECT
Primary Stockpile at Right, Followed by Crusher Buildings 1 and 2, Rod Mill Storage, Rod Mill, Stackers, and at Left, River Crossing

The product of these primary crushers is discharged onto one 60 by 108-in. magnetic vibrating feeder, which in turn discharges directly onto a 42-in. inclined belt conveyor. Traveling at a speed of 550 ft per min, the product is conveyed across the river to a surge storage pile. A concrete tunnel under this storage pile allows the material to be reclaimed and conveyed to the processing plant. It would have been more convenient had the processing plant been on the same side of the river as the primary crushers, for the mixing plant was by necessity also located on the right bank of the river.

Space limitations, however, as well as topographic conditions, did not permit this. As a consequence, the raw product is conveyed to the left bank and the processed material must be returned to the right bank. An overhead steel structure and hoist arrangement is provided at the primary crushers for removal of large-size stone which cannot go through the crushers or bridge across the rim of the crushers. The quartzite rock is very abrasive, and the crushers will have to be relined after the concaves have worn, to give a 6-in. crusher opening.

A primary stockpile is maintained ahead of the processing plant to avoid tying up the rest of the plant with quarry operations, and to provide a steady feed. A 42-in. belt conveyor carries the aggregate from the primary surge storage pile to crusher building No. 1. An emergency opening in the roof of the concrete tunnel under this storage pile is provided in case the feeder is down for repairs.

Crusher building No. 1 houses two 5 by 12-ft double-deck vibrating screens and two $4^1/_4$-ft standard cone crushers, with a setting of about $1^1/_2$ in. The material retained on the top deck of these screens (6 by $7^1/_2$-in. openings) is directed to the cone crushers for further grinding and gets back into the circuit again by means of a circulating conveyor. Any proportion of rock passing the top deck and retained on the lower deck of these screens ($3^1/_4$ by $3^1/_4$-in. openings) can be directed ei[ther] to the cone crushers or to a conveyor which carries sized material to the sizing plant.

The pan material from these screens is taken by con[veyor] to crusher building No. 2. This building like[wise] houses two 5 by 12-ft double-deck screens and two short-head cone crushers with about a $^3/_4$-in. setti[ng]. Any rock retained on the top deck ($1^5/_8$ by $1^5/_8$-in. op[en]ing) is directed either to the cone crushers or to the siz[ing] plant. Rock retained on the lower deck ($^7/_8$ by $^7/_8$ openings) follows the same procedure. The pan mate[rial] (minus $^7/_8$-in.) and the product from the short-he[ad] crushers, are taken by conveyor to the top of a su[rge] storage bin of 500-ton capacity.

Atop this bin are two 6 by 14-ft single-deck vibrati[ng] screens, equipped with screen cloth with $^3/_{16}$ by $^3/_{16}$ openings. Here it is necessary to draw off a propor[tion] of the material exceeding $^1/_4$ in. to supplement the [fine] rock storage, which is likewise taken to the sizing pl[ant]. The remainder of the product goes into the storage b[in] whence it is withdrawn for making sand. It should [be] emphasized that the quantity of each size of rock ma[de is] determined by the proportion used in the concrete m[ix]. The manufacture of these various sizes can be co[n]trolled quite definitely by the system of splitter gates a[nd] by-pass chutes that has been installed. The conve[yor] carrying material to crusher building No. 1 is equipp[ed] with a 48-in. diameter magnetic-head pulley for the [re]moval of tramp iron, to avoid any possible injury to t[he] crushing equipment.

SIZING PLANT

All rock picked up at the various discharge points [of] crusher buildings Nos. 1 and 2 and in the surge bi[n is] unsized and is conveyed to the sizing plant. This co[n]sists of three groups of two screens each, loca[ted] on the hillside paralleling a natural ravine. Here t[he] material is successively screened, and the oversize [is]

h screening operation is stored. n the 500-ton surge bin, storage erial is conveyed to two 9 by 12-ft s, where it is ground into sand by ns of rods. This type of mill was cted for making sand after labora- tests to determine the most suit- e equipment to install for this pur- , taking into consideration equip- t costs, particle shape of the shed sand product, amount of fines nus 100 mesh) to be wasted, metal sumption, and the subsequent use trategic war materials.

he two rod mills are driven by a le 800-hp motor, through a V-belt jaw-clutch arrangement. Use of a le motor was more a matter of ediency than anything else, as this was recently salvaged from a dredge p, and the delivery date on indi- al motors was unsatisfactory. In mill the rod charge is around 00 lb, made initially of an equal ht of $2^1/_2$-in., 3-in., and $3^1/_2$-in. diameter rods. Re- ement rods are $3^1/_2$ in. in diameter and are added t twice weekly to compensate for daily wear and to re a more uniform grading of the sand. This grading vary with the rod charge, as well as with the feed ugh the mills.

igh-carbon, chrome-steel, and silicon rods are being ; the latter are of electric-furnace steel rolled in Knox- . The wear consumption, including rods that have n down to a small core plus scrap rods—such as those have been broken or bent—approximate at this time t $^8/_{10}$ lb per ton of rod-mill feed. The grinding is a process, water being added at the feed end of the at the rate of about 30% water and stone by weight, to create the proper tion. The normal capacity of each mill is tons of feed per hour.

he product of the rod mills flows by grav- o a bowl-type hydroseparator 16 ft in di- ter by 5 ft deep. Here the first stage of rol is effected for the removal of minus mesh material. This control is by means he flow rate of the hydraulic separator, h can be varied by admitting a greater smaller amount of water at the feed he separator and also by varying the

QUARRYING OPERATIONS NEAR PRIMARY CRUSHERS—ELECTRIC SHOVELS USED

amount of water added at the discharge cone, which is especially designed for such injection. The product of the discharge cone is flumed into a 5 by 30-ft and a 7 by 30-ft rake-type classifier. Here the rest of the control is effected and the product dewatered. The finished product discharged from the classifiers has a moisture content of around 17%. Altogether, about 1,200 gal per min of water is used in connection with the classification of sand, including that added in the rod mills. The finished product is conveyed to a radial stacker which distributes the sand into storage over the main reclaiming tunnel. The waste product is carried directly to the river and amounts to about 16% of the rod-mill feed.

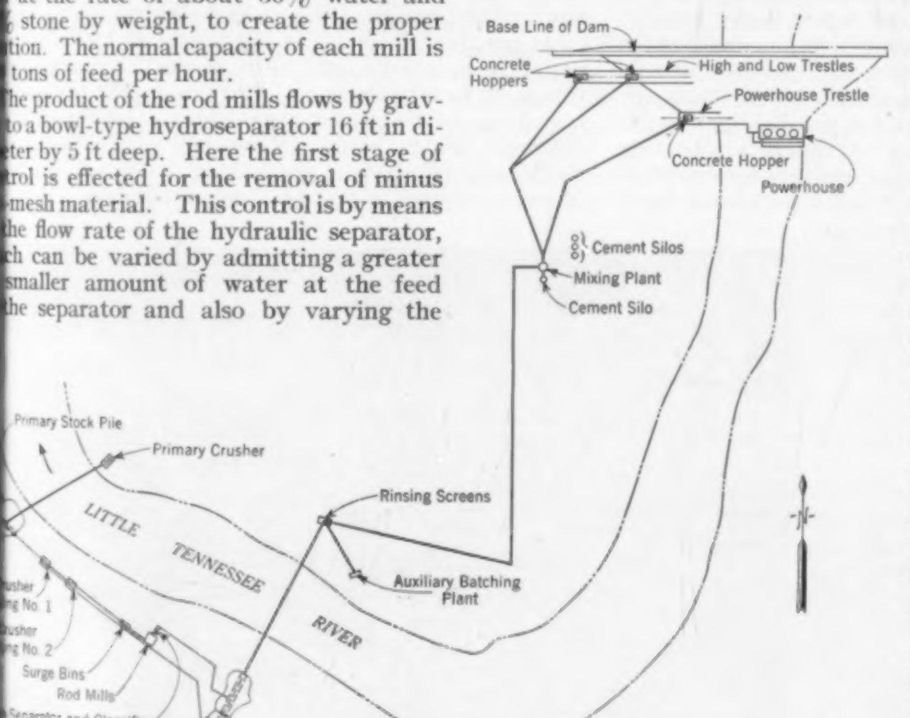


FIG. 1. CONSTRUCTION PLANT FACILITIES AT FONTANA PROJECT

Provision is made in the plant layout to by-pass the rod mills, sending the fines directly to the classification equipment. Ordinarily fines will be passed through the rod mills to improve the particle shape.

All the sized concrete aggregate is stored over a timber reclaiming tunnel located in a natural ravine. The total storage provided amounts to approximately 91,000 tons and the reclaimable storage, without bulldozing, to about 37,000 tons. Sufficient length of tunnel is allowed for sand, to permit further dewatering before reclaiming. Sand going into the mixing plant has a moisture content of approximately 8%. The timber reclaiming tunnel has openings in the roof through which aggregate can be removed by conveyor. The gates in this tunnel are manually operated, the operator receiving his instructions by signals from the turnhead operator stationed on top of the mixing plant as to the particular kind of material

FONTANA DAM SITE WITH CONSTRUCTION CAMP AND CONCRETE PLANT IN BACKGROUND

to go on the belt. Steam coils have been placed in the roof at the sand and fine-rock openings in case these materials freeze up in winter.

THE CEMENT PLANT

All cement is delivered in bulk in standard box cars to a railhead about 1,200 ft upstream of the dam. These are tracks on 18-ft centers and three unloading pits, 48 ft on centers. Six box cars can be unloaded simultaneously. The method is by manually operated power scrapers which dump the cement into a hopper between the two tracks. Each of the three unloading pits contains identical equipment—an enclosed chain-flight type of conveyor which moves the cement to a small surge tank 25 ft 10 in. from the hopper, and an air-activated cement blower under each surge tank which blows the cement through three 6-in.-diameter parallel lines to the silos. Over each hopper is a 4 by 7-ft magnetic vibrating screen for removing lumpy cement or other foreign matter. The entire plant is enclosed under a common shed.

The chain-flight cement conveyors travel at a speed of 28 ft per min and have a capacity of 250 bbl per hour. They are horizontal under the tracks and then inclined, discharging into surge tanks with a capacity of about 50 bbl. A flanged connection is provided on these conveyors to permit the use of cement hopper cars should these become available.

The air-activated cement blowers are loaded by gravity, then charged with air under pressure, and opened into a discharge line for blowing the charge of cement to the silos. Inside each tank is an air-ram-operated gate to permit charging the tank and to seal off the internal pressure built up during the aeration and discharge of the cement.

There are four cement silos, each 30 ft in diameter by 70 ft high, of 6,000-bbl capacity. The upper one is located adjacent to the mixing plant and the three lower ones in a group 60 ft downhill and 150 ft away from the mixing plant. One of the 6-in.-diameter pipe lines runs from the unloading terminal to the upper silo, a distance of about 3,000 ft, including a lift of about 290 ft. The other two pipe lines, of the same diameter, run to the two outside lower silos, a distance of about 2,950 ft, with a rise of about 260 ft. The three lower silos are so piped that when the outside ones are filled, the overflow enters the center one. This center silo thus tends to serve as a collector or vent, reducing the amount of cement escaping into the atmosphere.

No cement is pumped directly into the compartments in the mixing plant, all being rehandled from the four silos. This is accomplished again by the use of air-activated units. One such unit, located under the upper silo, blows the cement to the mixing plant, a lift of about 90 ft. Two similar units are provided for the three lower silos, connected to them by pant-leg chutes, and blowing the cement 285 ft with a rise of around 150 ft. The two cement compartments in the mixing plant are vented into the upper silo. The upper silo and the lower center silo are vented by means of a 10-ft diameter dust collector.

Approximately 1,200 cu ft per min of air is required for each of the air-activated blowers at the unloading terminal for a capacity of about 150 bbl of cement per hour. The blowers at the cement silos require about 500 cu ft per min of air. The lines enter the silos approximately tangentially, and swirl plates are provided near this point to take the wear. The cement for any concrete remaining to be placed after closure and filling of the reservoir, will be hauled to the dam site in special tank trucks and handled by the present facilities, which will be moved to the downstream side of the dam.

A CONE CRUSHER BEING INSTALLED

Wartime Transportation in Los Angeles

By D. Batman

Assistant to the President, Pacific Electric Railway Company, Los Angeles, Calif.

With 22 billion passengers demanding space on transit facilities in 1943, transport utilities are exceeding all previous operation records. Especially in areas congested with war workers has the provision of needed facilities been challenging. Such a center is Los Angeles, and such a utility is the Pacific Electric Railway Company. In that this company operates railroad, interurban, street car, and motor bus service, Mr. Batman's report gives an inclusive analysis of wartime transportation in the area. This paper was presented before the Engineering Economics Division at the Los Angeles Convention.

An indicated increase for 1943 of 36% in the total number of passengers carried in 1942, which in turn was an increase of 26½% over 1941—such is the outlook for the Pacific Electric Railway Company of Los Angeles. At the same time there is an indicated increase in freight—measured by gross ton-miles—for 1943 of 80% over 1942, which again had exceeded 1941 by 31%. Gross revenue in 1942 rose to 147% of the 1941 total and is expected to expand 60% in 1943. Yes, this picture looks bright indeed, but before we are swept away by these multiplying figures, (Fig. 1) let us consider the other side of the matter—the crowded facilities, the necessity of keeping equipment in constant service, and the difficulties in securing employees.

Staggered Hours for Business

When it became apparent that there would be an abnormal traffic increase in Los Angeles, business men and civic authorities realized that the cooperation of all would be required, and a voluntary plan of staggered hours for business was made effective. This spread the morning and evening peak loads, although not to the extent hoped for.

Traffic increases resulted in decided changes in the established riding habits of patrons. There was an increase in off-peak travel during the day, also in night travel. Normally traffic was lightest on Sunday with Saturday next; Monday and Thursday were about equal as regards maximum loads carried. Saturday is now the heaviest day and Friday is next. While Sunday traffic has increased substantially, it is still the lightest day. Although much heavier, traffic on the remaining days now shows little relative difference.

Traffic on Fridays and Saturdays is materially affected by the need for handling military personnel on leave, moving into and out of Los Angeles, but the cooperation of Army officials has made it generally possible to handle these movements at times of light civilian travel and when the necessary equipment is available. This also permitted handling this class of traffic on rail lines on which passenger service had been abandoned, particularly between Los Angeles and San Bernardino. The result has been a large saving in motor coach mileage, and is directly in keeping with the ODT policy of conserving rubber. The handling of inductees has required numerous special moves every day by both rail and motor coach. There are also numerous troop movements.

A large number of workers in defense plants located on the Company's lines are handled, but in the larger plants the greater proportion of the employees use private automobiles or special motor coach service provided by the plants. With the aid of government officials, studies were made of possible extensions of rail passenger lines to serve major aircraft plants in the territory, but unless conditions as to the use of private automobiles change materially, these are not likely to be constructed.

Special Service to Defense Plants

The Los Angeles Motor Coach Lines and the Los Angeles Railway (Fig. 2) furnish special contract motor coach service to some defense plants, operating from established rail heads on the Pacific Electric and Los Angeles Railway lines. The service is arranged to provide for return of the equipment for use during peaks of regular traffic.

The Los Angeles Motor Coach Lines, an operating agency, is owned jointly by the Pacific Electric and the Los Angeles Railway. In 1942 it handled 36,605,000 passengers, and the gross revenue was $3,036,000. In general it serves the territory west of the central business district of the city.

Elevated Rail and Motor Bus Terminal Constructed in Central Los Angeles

A RAIL LINE CONSTRUCTED TO SERVE A SHIPYARD
Coin-Actuated Turnstiles Speed Loading

To provide special service for employees of the California Shipbuilding Corporation between Los Angeles or Long Beach and the yards on Terminal Island, the Company, under contract with the U.S. Maritime Commission, recently completed construction of $2^3/_4$ miles of double-track rail line from its Long Beach Branch to the Cal Shipyards and 1.8 miles of second track necessary to complete double tracking of the Long Beach–San Pedro Line. To provide the necessary power, two 2,000-kw mercury-arc rectifiers were installed in substations at Terminal Island and at Watts, and in addition a 1,000-kw portable substation was constructed from motor generator sets which the Pacific Electric had on hand. For this service the Maritime Commission requisitioned 61 cars formerly used by the Southern Pacific on the Bay Bridge between San Francisco and Oakland. The equipment was converted for use on Company lines at the general shops in Torrance by replacing pantographs with trolley reconnecting motors, changing the voltage from 1,200 to 600, and applying field shunt switches to the motors to increase speed. The total cost of the work covered by the Pacific Electric contract was approximately one million.

This service, which was commenced March 19, 1943, is operated under contract. The Commission guarantees the operations, and the profits, if any, are divided equally between the Company and the Commission. The project was designed to handle a total of 10,000 passengers daily each way between Los Angeles and Terminal Island, and 5,000 passengers daily each way between Long Beach and the Island. It is now operating at approximately 20% of maximum capacity, and further increases will depend upon restrictions placed on gasoline, rubber, and the parking of automobiles on Terminal Island. Arrangements, not completed, also contemplate the use of the service by other government personnel. Equipment not required for present traffic is being used by the Company under arrangements with the Commission.

Summarizing, we find the Company with 459 rail cars and 382 motor coaches, carrying passengers on 21 rail lines and 33 motor coach lines at the rate of about 140 million per year. This compares with $81^1/_2$ million carried in 1941 with 408 rail cars and 317 motor coaches.

Exclusive Pacific Electric passenger operation involves daily 5,617 regularly scheduled trips, divided about equally between rail and motor coach lines, to which must be added the moves of the special traffic mentioned. As a major portion of all moves occurs in the 840 minutes between 5:00

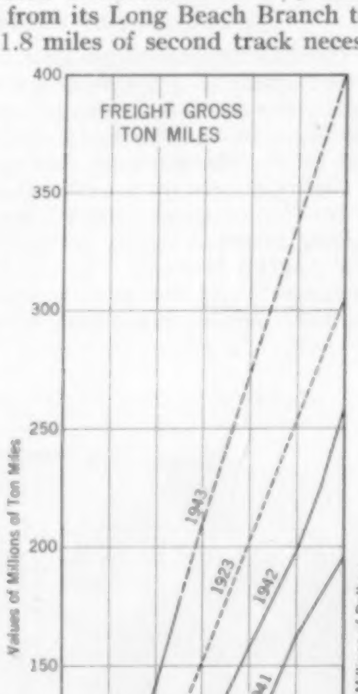
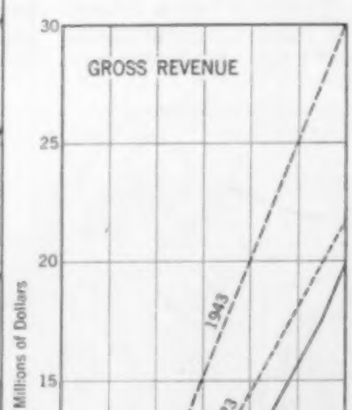
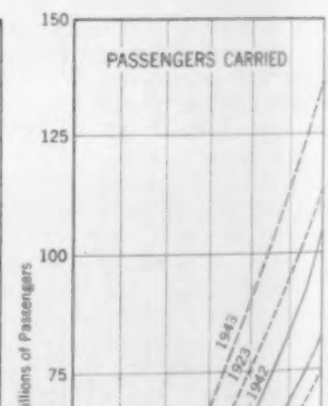


FIG. 1. OPERATING RECORDS OF PACIFIC ELECTRIC RAILWAY COMPANY





Garage Facilities Were Erected near Rail Shops for Centralized Maintenance Program

a.m. and 7:00 p.m., the passenger traffic alone provides a full-time job.

Restriction on tires, placed in effect in December 1941, had substantially increased traffic on longer rail and motor coach lines but did not greatly affect the shorter local lines; so that when gas was rationed in December 1942, it produced only about a 10% increase in traffic.

Careful analysis and study of increases that occurred in the 13 eastern states where gas rationing is more stringent indicates that similar restrictions here would necessitate handling about a 20% increase in traffic on the Company's lines. It is felt that by strict compliance with the staggered hour program, this additional traffic can be handled.

FREIGHT LOAD DOUBLES

In addition to the passenger load, there is the tremendously increased volume of freight, which for the first half of 1943 exceeded by $11^1/_2$% the total for 1941—measured by gross ton-miles—with indications that the 1943 total would more than double the 1941 figure of 195 million gross ton-miles. In 1942, 256 million gross ton-miles were handled. Freight revenue is now closely approaching passenger revenue. Gross revenue promises to exceed the 1942 total of $19,751,000 by 60%. In 1941, gross revenues were about $13^1/_2$ millions.

Freight movement involves 120 regularly scheduled trains daily, in addition to numerous special trains and an extensive box motor service handling mail, express, and freight in less than carload lots.

The volume and increase in freight traffic are well illustrated by comparison of cars handled per month through the Company's Los Angeles freight terminal facilities, where cars are interchanged with the three connecting transcontinental railroads. In June 1941, 53,000 cars were handled through these terminals; in June 1942 the number had risen to 69,200; and for June 1943, it was 117,850.

Supplies for the armed forces and materials essential to the war effort form the major part of the freight traffic, the handling of which involves many varied and interesting problems. During normal times freight was moved during night hours with minimum interference with passenger traffic. Now maximum use must be obtained from both motive power and freight equipment, a fact which necessitates prompt movement during all 24 hours of the day. It can be readily appreciated that, with the frequency of passenger and freight movements, intensive supervision is required. Supervisory forces are now about $2^1/_2$ times the peacetime staff, and to handle the rail traffic, dispatching districts have been increased from 3 before the war to 5.

It has been necessary to supplement electric motive power with a number of steam engines. Handling of the heavy loads and the operation of steam locomotives on lines originally designed primarily as passenger lines has necessitated additional yard facilities and sidings, changes in existing layouts to provide easier turnouts and curves, and other miscellaneous facilities.

Increasing loads have required installation of heavier rail on the heavier freight lines. Approximately $16^1/_2$ miles of track of 60 and 70-lb rail have already been relaid with 90-lb rail as part of the program for relaying about 50 miles of track.

PROPERTY AND PERSONNEL

A rehabilitation program, started in 1939, contemplated picking up deferred maintenance over a period of years, but heavy traffic has accelerated the plan. Difficulty in securing men and the large amount of new construction required to serve war industries prevented increasing the program as rapidly as desired. Track maintenance forces were gradually enlarged but a serious shortage in ties then developed, which has only recently been cleared up. The situation is now such that it is hoped in the near future to maintain tie renewals at the rate of not less than 12,000 per month.

The problems of securing and holding personnel under present conditions are of major importance, and it has been necessary to raise age limits and reduce experience requirements. It is anticipated that the War Manpower Commission's Employment Stabilization Plan, recently made effective in this area for all essential activities, and to which the Company subscribes, will improve the situation. Because of the character of the work and types of equipment operated, women have not been employed in train or motor coach service. In clerical work men have been largely replaced by women, the policy being to shift men to the heavier jobs when their work can be satisfactorily handled by women. Women

FREIGHT BEING MOVED BY 44-TON 380-HP DIESEL ELECTRIC LOCOMOTIVE
Trolley Actuates Wigwag Signals at Highway Crossings

are employed in the shops in many capacities, and as operators of interlocking towers.

Employees entering train service, both at normal times and at present, are required to complete a thorough course of instruction. In other departments, new employees were generally required to meet experience requirements and were not given a course of training such as was given those entering train service. However, inexperienced employees are now accepted in all departments and trained. There are now about 6,000 employees in service, as compared to 4,100 in 1941. The present average turnover amounts to about 425 employees per month, or $7^1/_4$% of the total, which requires interviewing of about 1,200 persons a month by the Personnel Department.

Equipment is another important factor involved. The Company has had 90 motor coaches on order for over a year. An allocation from the ODT for 30 of these was secured and they are now in service. An allocation was also obtained for two 44-ton diesel electric switchers, which were recently placed in service. A gas electric passenger coach has been converted for use as a switching locomotive by reducing its over-all length from 72 ft to 43 ft. Work is now under way on four additional such units.

Despite heavy and continued use and shortage of parts, it has been possible to hold the "out-of-service" equipment down to about 8% of the total; this has been due in a large measure to the amount of new equipment secured and to the work done on the older equipment under the rehabilitation program.

OLD POWER EQUIPMENT IN SERVICE

Power consumption is now about 40% greater than in 1940. Prior to the war a program of conversion of manually operated substations for automatic operation and installation of additional units of equipment had been undertaken. This was recently completed, and is of material help in meeting the present situation. Much of the older substation equipment, which was to have been scrapped, had to be put back in service. Some of this was utilized in the construction of three additional portable substations. Materials, especially copper, recovered from abandoned lines have helped greatly in maintaining the electric system.

Maintenance of way and structures, always a major problem, is doubly so now. The situation as to rail and ties has been mentioned, but the maintenance of bridges, buildings, signals, and interlocking plants, together with much new construction, is also greatly complicated by war conditions. This subject alone constitutes a most interesting story. Purchase and use of materials and supplies now present an apparently infinite number of complications. The necessity of training inexperienced help, of conforming to rules and regulations in ever increasing numbers, coupled with increased business, has created a situation in the general auditor's office almost as complex as the traffic problem.

TREMENDOUS INCREASES HANDLED SINCE PEARL HARBOR

It is worthy of note that despite the necessity for increasing the total number of employees approximately 50%, and for replacing a substantial percentage of experienced employees with personnel that was to a large extent inexperienced, it has been possible to handle the tremendous increase in business that has occurred since Pearl Harbor. In this period gross revenues have more than doubled, passenger traffic has increased 68%, and freight traffic, measured in gross ton-miles, has increased altogether 180%.

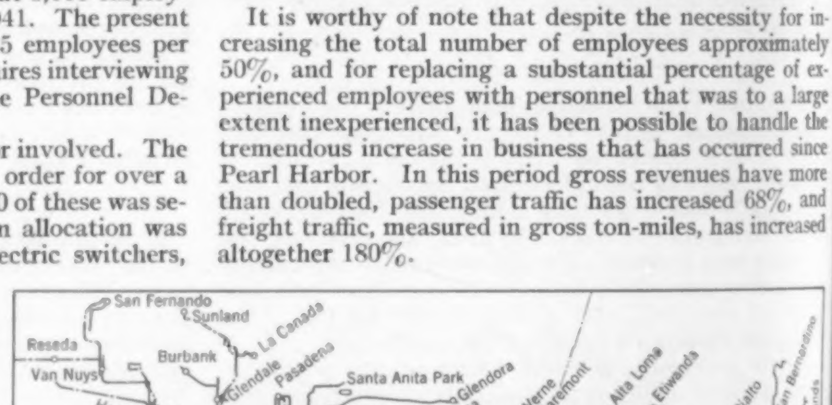


FIG. 2. RAIL AND MOTOR COACH LINES OF THE PACIFIC ELECTRIC COMPANY IN THE LOS ANGELES AREA

Manpower in Construction

Part II. Check and Balance System of Labor Management

By L. E. Brigham, M. Am. Soc. C.E.

Labor Relations Officer, Construction Division; Office, Chief of Engineers, War Department, Washington, D.C.

Good labor management speeds up the job and reduces costs. It results in high worker morale plus craftsmanship and can be measured by comparative unit labor cost data. In this paper Mr. Brigham outlines a check and balance system of evaluating factors conducive both to high morale and to construction economies. In Part I, in the October issue, job costs were discussed.

Construction is essentially a partnership whereby owner, contractor, and labor each perform the specialized functions for which they are best fitted. The reported high cost of wartime construction is well known. The question of how to reduce this cost constitutes a direct challenge to each of these parties—to the contractor, who must prove his ability and desire to render the management service for which he is employed; to organized labor, whose function it is to furnish competent workmen; to the contracting agency representing the owner, who must see to it that contractor and labor each perform their allotted function. Unreasonable completion schedules, shortages of materials and uncertainty as to their delivery, unfavorable project sites, weather conditions, labor shortages, and competitive practices, have all been contributing factors to excessive costs. These factors increase the challenge to render good labor management.

Table I. Check List of Factors Outside the Project

1. Labor Supply
   - *a.* What is the labor supply area for the project?
   - *b.* What proportion of labor is local and non-local?
   - *c.* In what trades have labor shortages existed?
   - *d.* What are the labor supply needs for the project?
2. Housing
   - *a.* What are the main residence areas of workers?
   - *b.* Are rents fair?
   - *c.* Are premises overcrowded? Are they clean and healthful?
   - *d.* Are conditions satisfactory as to food, water, fuel, and sanitation?
   - *e.* Should housing and commissary facilities be made available on the job?
   - *f.* Does any undesirable political or gambling racket exist?
3. Transportation
   - *a.* How do workmen get to and from the project?
   - *b.* What is the approximate time consumed in travel each day?
   - *c.* Are travel conditions safe?
   - *d.* Are parking facilities provided?
   - *e.* Are transportation costs excessive?

The attitude of the employer in the handling of labor may generally be classified under one of the following two extremes:

1. The paternalistic attitude, by which all power, authority, and rights flow from the employer down, and the workman is in a condition approaching servitude. This general attitude, while commonplace a number of years ago, is now considered outdated in most private concerns.

2. The line of least resistance is taken by some employers, particularly on fixed-fee projects. Under this practice, the rights of the workers, either real or fancied, and the wishes of the representative unions are given full scope.

Both of these labor policies result in poor economy with low production by workers and high unit labor costs. The check-and-balance system outlined in this discussion is somewhat of a medium between these two extremes. By this system, both the employer and the employee are delegated definite responsibilities on the job, and a continuous check is made by the contracting agency to see that both parties discharge their responsibilities.

The key to good labor management lies with the individual employee. The individual is the least common denominator, the unit or the single brick in the wall of production. He must be selected properly, treated fairly, and satisfied that he is getting a square deal and that no injustice or favoritism prevails. As indicated in Fig. 1, the individual has two elements that are necessary for production: (1) energy, (2) skill. The release of energy applied to skill begets production. This release of energy and application of skill come from within the individual and must be given voluntarily and cannot be taken from him by coercion.

Conditions Affecting Worker's Output

The individual's skill gradually increases with use and training, and decreases through lack of use. His energy fluctuates daily. The handicaps of poor housing, travel, living conditions, lack of recreation, and long hours, which must be surmounted by war workers have in many cases sapped their energy reserve to the point of endangering health and making even reasonable production impossible. The popular theory that an extension of working hours brings increased production is often a fallacy, as the worker's energy may thereby be decreased beyond the point of maximum returns.

For the most efficient operation, the workman must be properly selected, well slept, well fed, well clothed, and arrive at the place of work in the best condition. A continuous and systematic follow-up must be instigated to maintain the individual in good condition. Some of the production factors that should be investigated are indicated in the check lists, Tables I and II.

Good labor management can only result through patient and persevering effort and not through wishful thinking or directive. To be effective, it must be a continuous process—an everyday working tool. The contracting agency and the contractor should each centralize the responsibility of labor management through one man well informed on all phases of construction. From the standpoint of the contracting agency, he should have good practical construction experience plus a technical and engineering viewpoint. Many construction engineers are so qualified. The responsibilities of this individual would be twofold:

1. To check continually with the contractor's representative

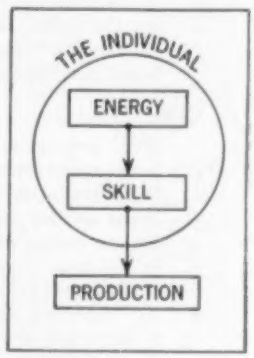


Fig. 1. The Unit of Production

on this phase of the work and make sure that the contractor is fulfilling his responsibilities.

2. To inaugurate such independent cost studies as are necessary to check the unit cost data submitted by the contractor.

It is desirable for the contractor to delegate similar functions to a man who has had experience in handling men, such as a foreman or superintendent. This man should also be intimately acquainted with construction practices. At the same time, he should have a reputation for openmindedness and fair dealing with labor. It is recommended that the operation of the personnel office be a part of this man's work. The past practice of dividing this responsibility, with the management taking over the broader phases of labor management, and delegating the routine work to the personnel office, has divided responsibility and increased costs.

SELECTION, RECLASSIFICATION, GRIEVANCES

The proper selection of all employees is fundamental to good labor management. A definite screening procedure should be established for each project whereby each prospective employee is interviewed by men of known competence in the trade or occupation in which the applicant seeks employment. Great care should be exercised in the selection of foremen as they are the critical element in attaining good production. In many cases, entire reliance for the selection of employees is placed upon the unions or referral agency. This practice is poor economy and results in the employment of many misfits and unqualified workmen.

It is extremely desirable that a systematic reclassification procedure be established if a high degree of morale is to be maintained among workmen on the project. Even with the best screening or selection procedure, poor employees are bound to slip in who are not qualified for the work they are hired to perform. Such a poor employee is not only a poor investment in himself, but also immediately pulls down the productiveness of the other employees he associates with. To conserve manpower, all employees who are removed from the work they have previously performed should be properly reclassified in conformity with their abilities. The better grade of workmen found in the process should be reclassified upward in conformity with their abilities and the opportunities for work on the project. A systematic procedure as to exit interviews is highly desirable to attain equitable reclassification, show up weak spots in organization, and conserve the manpower already available at the project. In almost any group of employees, there is combined background of experience and ability sufficient to solve almost any problem. In a wisely administered project, the development of these latent abilities and experiences will be encouraged to the fullest.

Many grievances arise, of a petty or serious nature, which greatly impede the production of the employees concerned. The grievances of any one employee not only retard his own work, but seriously affect the work of all others with whom he comes in contact. It is therefore desirable on a project of any consequence to set up an office in a readily accessible place for the purpose of hearing complaints and receiving suggestions. Such an of-

Table II. Check List of Factors Inside the Project

1. Transportation on the Project
   - a. How do the workmen get from point of arrival to their job?
   - b. How much time is involved?
   - c. Are the workmen paid for this time?
   - d. How do the workmen travel from task to task? Time? Cost?

2. Employment Conditions
   - a. Is the job closed, open, or preferential shop?
   - b. Where does the contractor place orders for workmen?
   - c. Who fills these orders?
   - d. Are these orders filled promptly?
   - e. How are the workmen referred to the project?
   - f. Where and by whom are the workmen placed on the payroll?
   - g. What is the source of supply for foremen and superintendents?
   - h. Do any employment rackets exist?

3. Wages
   - a. Does the wage scale comply with agreements and regulations?
   - b. Are the wages such as to attract and keep good men?
   - c. Do the men feel that the wages are fair?
   - d. Are the unions insistent on wage increases? Why?
   - e. Are the workmen qualified to earn the wages paid?
   - f. What situation exists concerning overtime requirements?

4. Union Activities
   - a. What unions are active on the project?
   - b. What is the general attitude of union officials?
   - c. What are initiation fees? How and where are they paid?
   - d. What are the dues and how and where are they collected?
   - e. Do the unions have representatives on or near the project?
   - f. If the contractor is unionized, how does he check to see that his employees are union members in good standing?
   - g. Are there any union rackets?
   - h. Is there any unrest due to union activities?
   - i. Do the unions permit non-union employees where they cannot supply union members?
   - j. Have the unions made jurisdictional demands which tend to increase costs?

5. Selection of Workmen
   - a. Are foremen and superintendents properly selected?
   - b. Is there a systematic process for selection of workmen?
   - c. Is the determination of prequalification left entirely to the union or other source of referral for employment?

6. Supervision of Workmen
   - a. Is the supervision competent?
   - b. Does the foreman have a well-balanced crew?
   - c. Do superintendents give close supervision to each crew?
   - d. Does fair play exist between the superintendent, foreman, and men?
   - e. Is the job overloaded with men?
   - f. Is each crew effectively organized?
   - g. Are there delays caused by lack of materials or equipment?
   - h. Have facilities been provided where employees may give ideas for improvement and register "kicks"?

7. Working Conditions
   - a. Are the physical conditions on the job good?
   - b. Are the men protected from the weather?
   - c. Do they have a proper place to change clothes and a safe place to store their tools?
   - d. Do they have a proper lunch and place to eat it?
   - e. Are the men properly clothed?
   - f. Are conditions such as to promote safety?
   - g. Are sanitary facilities provided?

8. Culling and Reclassification of Workmen
   - a. Have poor workmen been weeded out?
   - b. Have poor foremen and superintendents been weeded out?
   - c. Have misfits been reassigned?
   - d. Have qualified workers been advanced?

9. Unit Labor Costs
   - a. Are unit labor costs systematically kept?
   - b. Are such costs kept for typical jobs?
   - c. Are unit labor costs used as a current tool?
   - d. Are unit labor cost data exchanged with other projects?

fice should not be in name only. The complaints and suggestions should be given close attention and follow-up. An office of this type will have a very beneficial effect in raising morale on the project, and the benefits received from suggestions offered will prove an extremely good investment.

The keeping of unit labor cost data is a prime function of good labor management and must be kept up to date at all times and utilized as a current tool in controlling the cost of construction. Gross costs made at the completion of the project, giving the over-all costs of materials in place, are of little value. The purpose of unit costs is: (1). To control the labor costs on current work. (2). To give adequate actual labor cost information for use in estimating future work.

Adequate cost-checking facilities should be set up on each project. Two types of unit costs should be kept: (1) spot costs on typical phases of construction, and (2) cumulative costs of labor on segregated types of material. The spot cost can be used to check the cumulative cost and vice versa.

Project unit costs should be compared with those obtained on other projects of a similar nature. Such comparative data, both of spot costs and cumulative costs, are extremely valuable in indicating situations in need of improvement. It is, of course, necessary that all cost data be kept according to a standard pattern or form to make possible comparative use. (See Fig. 2.)

Unit cost data to be effective must be continually used on a competitive basis to check and improve current conditions. Spot cost data may best be used in keeping superintendents and crew foremen advised as to results accomplished under their direction. It is often possible to keep spot costs on identical or similar types of work being done under different superintendents and foremen. For instance, in the construction of identical barracks, total labor costs could well be kept segregated for each building and foreman. For competitive purposes, summaries of spot costs should be placed in the hands of each superintendent and foreman doing similar work, properly identified as to foreman and other factors. By this means labor costs on identical structures have been reduced by half in the course of a job.

SPOT COST

Date ______ Operation Concrete piers ______

Working Conditions ______ Project ______

______ Area Engineer ______

______ Contractor ______

Working location on project ______ Superintendent ______

______ Foreman ______

______ Checker ______

Job description: Mixing and placing concrete for piers and footings for standard ______ building, type ______
Size piers 8 x 8 miscellaneous heights to grade. Job includes placing runways for wheel barrows, cutting and placing reinforcing steel bars, bolts, and dowel pins. Mixer used was of portable type 3½ c. f. capacity. Considerable delay caused by stalling of motor. Wastage and all cost factors included. Moving equipment and general supervision included with overhead.

Quantity placed: 12.09 c.y. of 1 2½-5 concrete.

Labor		Job Totals		Per cu. yd.	
	Rate	Hours	Cost	Hrs/unit	Cost
1 Foreman	$1.00	12	$12.00	.99	$ .99
3 S.T. Labor	.75	39	29.25	3.22	2.42
3 Com. Labor	.44	39	17.16	3.22	1.41
Totals: -			$58.41		$4.82

Material		Job Totals		Per cu. yd.	
Item	Price	Quantity	Cost	Quantity/unit	Cost
½ Ø Reinf. steel	.039	189 lb.	7.36	15.37 lb.	.60
½ Ø " "	.06	12 lb.	.72	.99 lb.	.06
½ x 8 Arch. bold.	.056	57 ea.	3.18	4.72 ea.	.26
½ x 18 " "	.097	36 ea.	3.48	2.98 ea.	.29
Cement	.64	57 sk.	36.48	4.72 sk.	3.01
Sand	1.75	7½ c.y.	13.14	.62 c.y.	1.09
Gravel	1.75	12 c.y.	21.00	.99 c.y.	1.73
Totals: -			$85.26		$7.04

Summary per cu. yd.:

Labor - $4.82 Material - $7.04 Overhead - 8.80% $1.04 Total: $12.90 c.y.

FIG. 2. TYPICAL SPOT COST SHEET

NOTE: *These discussions represent the opinions of the author and do not necessarily reflect the policies or attitudes of any government agency.*

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Problems

New Chart for Culvert Design

By R. ROBINSON ROWE, M. AM. SOC. C.E.

SENIOR BRIDGE ENGINEER, CALIFORNIA DIVISION OF HIGHWAYS, SACRAMENTO, CALIF.

THE reluctance on the part of designers to use formulas to determine the size and proportions of culverts can be explained by the intricacy of the equations involved. To compile a list of alternative culvert barrels for one particular site requires cut-and-try solutions of several formulas that are complicated by fractional exponents. Brief tables and charts are included in the pamphlet, *Flow of Water Through Culverts*, by Yarnell, Nagler, and Woodward, published by the State University of Iowa in 1926, but extension of these to cover the field of modern culverts would be of awkward proportions. This pamphlet was referred to by Prof. F. William Greve in his paper on "Bridge and Culvert Flow Areas," in the August issue of CIVIL ENGINEERING.

Since the formulas in the Iowa pamphlet are not adaptable to nomographs—although approximations for small ranges have been published—the writer prepared Fig. 1 [see page 544] for his own use. It carries a self-explanatory text illustrated by a practical example. Of course, no such tool can be universally applied; designers must assure themselves that the entrance head conforms to the special test (right center) and that velocity in the barrel and at the outfall is tolerable for short periods.

The arches shown are not universal designs. With negligible error, arches of common proportions can be selected by interpolation with respect to the arch areas shown. No apologies are offered for the extrapolation of the Iowa formulas in all three dimensions to nearly seven times the laboratory specimens and to two additional textures—that of corrugated multiplate and that of spun concrete pipe. Seven is not a large prototype-model ratio in hydraulics, and the Iowa research stands as the most thorough yet published in this field.

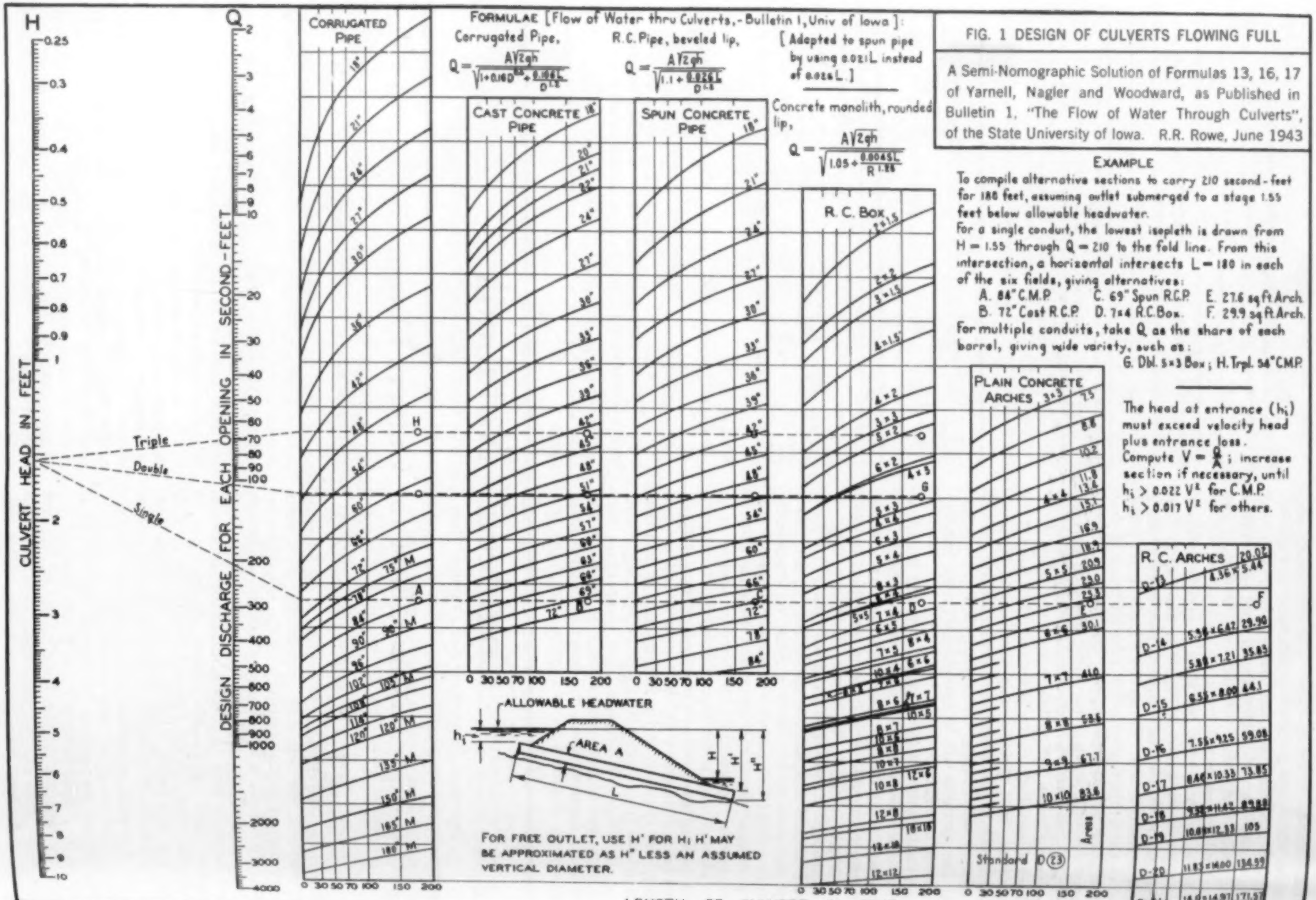


FIG. 1 DESIGN OF CULVERTS FLOWING FULL

Determination of Moments in Continuous Beams with Concentrated Loads

By ODD ALBERT; Assoc. M. Am. Soc. C.E.

BELMAR, N.J.

To determine the negative moments in a continuous beam, caused by symmetrically arranged concentrated loads, when moments caused by uniformly distributed loading are known, it has been found convenient to employ a conversion factor. This factor is used in a direct relationship, as expressed by

$$M^p = M^q\,(1 + 1/n) \quad \ldots\ldots (1)$$

where n = number of equal spaces between concentrated loads. Thus for one load, $n = 2$; for 2 loads, $n = 3$, etc.

M^q = the negative moment at a certain support of a continuous beam for a loading of q lb per ft on certain spans of the beam

M^p = the negative moment at the same support under a loading of concentrated symmetrically arranged loads P on the same certain spans

This expression is true only when the sum of the concentrated loads on one span equals the total uniform load on its counterpart. That is, $P(n - 1) = qL$.

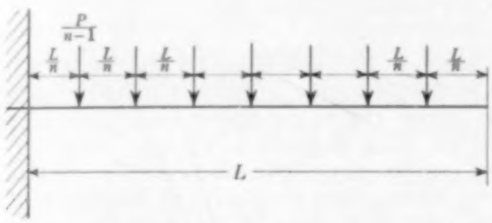


FIG. 1. CANTILEVER BEAM WITH SYMMETRICALLY SPACED CONCENTRATED LOADS

This relationship may be determined by a preliminary analysis of a cantilever beam under certain loading conditions. If a cantilever beam (Fig. 1) is subject to $n - 1$ concentrated loads symmetrically placed, the spacing between the loads and between the first and the last load and the ends of the beam is L/n. Solving for deflection of the free end of the beam due to the load nearest the support, we get

$$\delta = \frac{PL^3(3n - 1)}{(n - 1)\,3EI\,2n^3} \quad \ldots\ldots (2)$$

For the second load, the deflection at the free end is

$$\delta = \frac{PL^3}{(n - 1)\,3EI}\,\frac{4(3n - 2)}{2n^3} \quad \ldots\ldots (3)$$

For the third load, the deflection is

$$\delta = \frac{PL^3}{(n - 1)3EI}\,\frac{9(3n - 3)}{2n^3} \quad \ldots\ldots (4)$$

For the last load, the deflection of the free end is

$$\delta = \frac{PL^3}{(n - 1)\,3EI}\,\frac{(n - 1)^2\,3n - (n - 1)}{2n^3} \quad \ldots (5)$$

If all these loads are applied at the same time, the deflection of the free end must equal the sum of these deflections.

$$\delta = \frac{PL^3}{(n - 1)\,3EI} \times \frac{(3n - 1) + 4(3n - 2) + 9(3n - 3) + \ldots (n - 1)^2[3n - (n - 1)]}{2n^3} \quad \ldots (6)$$

This expression becomes

$$\delta = \frac{PL^3(3n - 1)}{24\,EI\,n} \quad \ldots\ldots (7)$$

COMPARISON WITH UNIFORMLY DISTRIBUTED LOADING

If the value of n in Eq. 7 approaches infinity, the condition of a uniformly distributed load is approached. Then Eq. 7 becomes

$$\delta = \frac{PL^3}{8EI} \quad \ldots\ldots (8)$$

THE NEGATIVE MOMENTS IN A CONTINUOUS BEAM

With this relationship established, it is possible to apply a similar analysis to a continuous beam. For instance examine the beam shown in Fig. 2, having the second span loaded with $n - 1$ loads. The deflection angles at supports B and C are assumed to be

$$\phi_2^m = \frac{M_2^B L_2}{3\,EI}\,m_2 \quad \ldots\ldots (9)$$

$$\phi_2^n = \frac{M_2^C L_2}{3\,EI}\,n_2 \quad \ldots\ldots (10)$$

where m_2 and n_2 are the angle constants, depending upon the conditions to the left of support B and to the right of support C, respectively.

If now beam BC is cut out of the system and assumed fixed at B, with all the reactions applied as loads, then the deflection of end C can be determined.

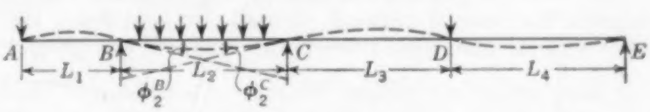


FIG. 2. CONTINUOUS BEAM WITH ONE SPAN LOADED

The angle ϕ_2^m makes the end C go down an amount $\theta_2^m L_2$; the loads make it go down amount $\frac{PL_2^3(3n - 1)}{24\,EI\,n}$; the moment M_2^C makes it go down $\frac{M_2^C L_2}{2\,EI}$; and the reaction in C makes it go up $\frac{CL_2^3}{3\,EI}$. Support C is fixed; therefore the sum of all these movements must equal zero. Hence,

$$-\phi_2^m L_2 - \frac{PL_2^3(3n - 1)}{24\,EI\,n} - \frac{M_2^C L_2}{2\,EI} + \frac{CL_2^3}{3\,EI} = 0 \ldots (11)$$

A moment equation about support B will give

$$C = P/2 + M_2^C/L_2 - M_2^B/L_2 \quad . \quad . \quad . \quad . \quad (12)$$

By substituting the values for ϕ_2'' and C in Eq. 11, we get

$$2M_2^B(m_2 + 1) + M_2^C = \frac{PL_2}{4}\left(1 + \frac{1}{n}\right). \quad . \quad . \quad (13)$$

If we now consider the same beam BC fixed at C instead, and determine the deflection of the end B, we will get

$$2M_2^C(n_2 + 1) + M_2^B = \frac{PL_2}{4}\left(1 + \frac{1}{n}\right). \quad . \quad . \quad (14)$$

By eliminating M_2^C from Eqs. 13 and 14, we will get

$$M_2^B = \frac{PL_2(2n_2 + 1)}{4[4(n_2 + 1)(m_2 + 1) - 1]}\left(1 + \frac{1}{n}\right). \quad . \quad (15)$$

The preceding expression is general with no limitations. The first part may be simplified by the substitution of values for m_2 and n_2. It can be applied to any kind of structure.

When the same beam is subject to a uniform loading of q lb per ft instead of the $n - 1$ concentrated loads, then Eq. 11 becomes

$$-\phi_2''L_2 - \frac{qL_2^4}{8EI} - \frac{M_2^C L_2}{2EI} + \frac{CL_2^3}{3EI} = 0 \quad . \quad . \quad (16)$$

and Eq. 12 becomes

$$C = qL_2/2 + M_2^C/L_2 - M_2^B/L_2 \quad . \quad . \quad . \quad . \quad (17)$$

so it can easily be seen that Eqs. 13 and 14 become, respectively,

$$2M_2^B(m_2 + 1) + M_2^C = qL_2^2/4 \quad . \quad . \quad . \quad . \quad (18)$$

and

$$2M_2^C(n_2 + 1) + M_2^B = qL_2^2/4 \quad . \quad . \quad . \quad (19)$$

Eliminating M_2^C from Eqs. 18 and 19 we get

$$M_2^B = \frac{qL_2^2(2n_2 + 1)}{4[4(n_2 + 1)(m_2 + 1) - 1]}. \quad . \quad . \quad (20)$$

If Eq. 20 is compared with Eq. 15, it will be seen that the moment M_2^B caused by $n - 1$ concentrated loads is $1 + 1/n$ larger than the moment M_2^B caused by a uniformly distributed loading, under the condition that $\Sigma P = qL_2$.

Pneumatic Device Launches Floating Dry Docks

By O. H. Pilkey, Assoc. M. Am. Soc. C.E.
Structural Engineer, Chicago Bridge and Iron Company, Chicago, Ill.

Floating drydocks constructed for the Bureau of Yards and Docks, U.S. Navy, by the Chicago Bridge and Iron Company near Newburgh, N.Y., when completed are side launched into the Hudson River. During construction the docks are supported on a number of fixed piles. When a dock is ready to be launched, its weight is shifted from these fixed piles to launching cradles resting on ground ways spaced about 48 ft apart. This is done by driving wedges between the launching cradle and the bottom of the dock so as to raise it off the fixed piles. The launching cradles in every case come directly under either a transverse truss or a bulkhead. To keep the cradles on the launching ways, guide channels are provided on the two outside ways at each end. These guide channels extend for the entire length of the launching cradle or sliding way.

The launching cradles or sliding ways are made continuous for several reasons. First, the load from the dock will be distributed more uniformly to the ground ways. Second, the launching cradle must be strong enough so that it can be supported at its two ends when held up under the water-borne dock after launching. Third, if the dock happens to tip into the water as the center of gravity passes over the end of the ways during launching, there is less possibility of damage to the hull or to the interior framing of the dock from the sudden increase in, and great concentration of, pressure on the dock at this point. The launching cradles are held up against the dock with cables and can be removed from under the dock at any time after the launching.

The ways (Fig. 1), which have a slope of 1 to 10, are carried to 8.5 ft below the water surface. This depth affords little risk of damage to the dock caused by its tipping off the end of the ways into the water and rolling back onto the ends of the ground ways. In all the launchings on these docks, there has been no tipping visible to the eye. To reduce friction, 1/2 in. of launching grease is applied between the cradles and the ways

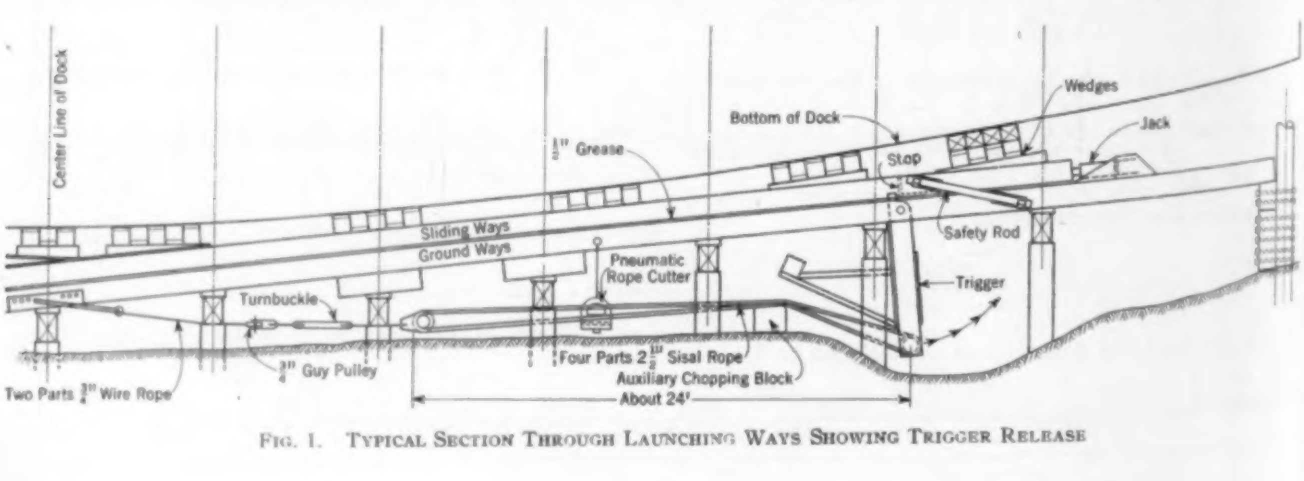
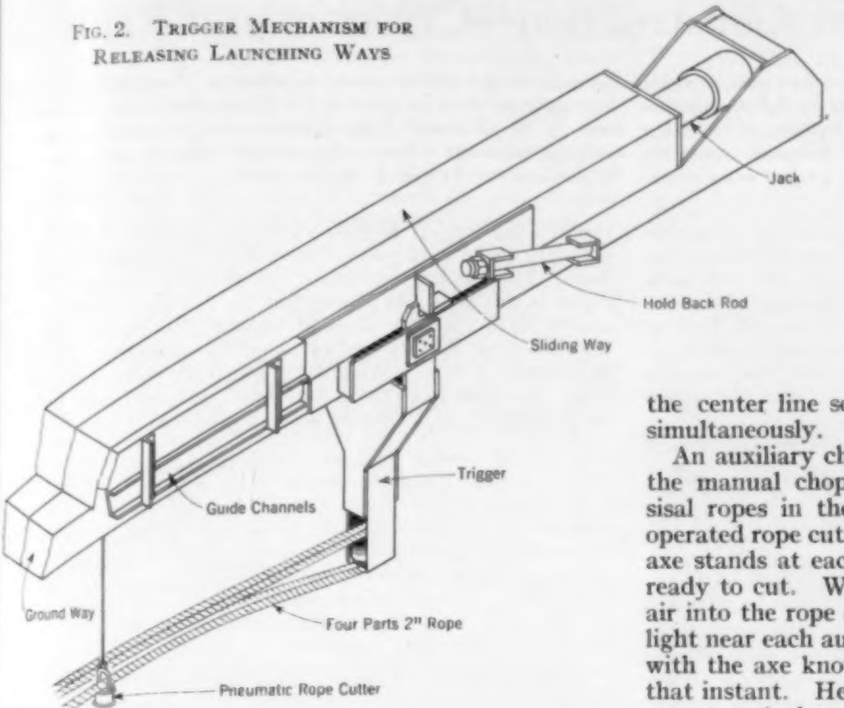


Fig. 1. Typical Section Through Launching Ways Showing Trigger Release

FIG. 2. TRIGGER MECHANISM FOR RELEASING LAUNCHING WAYS



When launched, the dock reaches a maximum velocity of about 18 ft per second. The coefficient of friction then becomes between 2 and 3% of the gross weight.

At the shore end of each launching way, there is a releasing trigger (Fig. 2) which consists essentially of a holdback or safety rod to prevent possibility of premature movement of the dock, a trigger for releasing the dock when so desired, and a jack for starting the dock in the event that it does not move of its own accord. After the safety rods have been burned off, the trigger is released by severing a $2^1/_2$-in.-diameter sisal rope with a pneumatic rope cutter. The cutter consists of an air cylinder with a knife blade attached to one end of the piston. The knife blade moves in a groove in a yoke which holds the rope.

There is one rope cutter for each of the ways. All are operated from one valve so as to obtain a simultaneous cutting of all the ropes. To prevent premature cutting of the rope, the shut-off valve on the air line is of the 3-way type, so arranged that the rope cutter is open to the atmosphere except when air is intentionally turned into it.

Thus pressure caused by leakage through the shutoff valve cannot be built up in the rope cutter cylinder. The arrangement of pipes leading to the rope cutters is symmetrical about the center line so that the air will reach all the cutters simultaneously.

An auxiliary chopping block is placed so as to permit the manual chopping of each of the $2^1/_2$-in.-diameter sisal ropes in the event that one or more of the air-operated rope cutters do not work. A man with a broad axe stands at each chopping block with his axe poised, ready to cut. When the 3-way valve is turned to pass air into the rope cutters, a switch closes and turns on a light near each auxiliary chopping block so that the man with the axe knows that the rope should be severed at that instant. He does not wait to see whether the rope cutter works but swings his axe regardless.

The triggers are provided with counterweights which cause them to swing freely and easily into the open position. The sliding ways thus do not have to overcome any friction or other force in order to make the triggers work. The bottom of each trigger is fastened to the ground ways by means of a yoke, two parts of $^3/_4$-in. wire rope and a $1^3/_4$-in. guy tightener turnbuckle having a 3-ft take-up. Special rope fittings are provided so that the rope will not have to turn a sharp corner.

Design of the various launching methods was worked out under the supervision of O. A. Bailey, Chief Engineer of the Chicago Bridge and Iron Company. I. L. Wissmiller is Manager of the Newburgh yard. Lieutenant Gordon H. Hill was the Resident Officer-in-Charge for the Bureau of Yards and Docks, U.S. Navy.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Effect of Runoff from Small Undeveloped Areas on Culvert Design

TO THE EDITOR: The article by Professor Greve in the August issue, entitled "Bridge and Culvert Flow Areas," might be called a review of our ignorance on the subject of the effect of runoff from small undeveloped areas on culvert design.

In the absence of other acceptable data, engineers continue to estimate runoff rates and culvert sizes from formulas which should by now have been given an honorable retirement, since they have outlived their usefulness. In place of these formulas, new standards should be devised, based on analyses of actual records of runoff from small areas.

The U.S. Geological Survey and the various branches of the Department of Agriculture have accumulated a mass of data on runoff from small natural areas. For example, in the Surface Water Supply Papers of the Survey—covering the North Atlantic Slope Basins—there are records totaling 600 station-years for drainage areas of less than 30 sq miles, 400 station-years for areas less than 20 sq miles, and even 100 station-years for areas less than 5 sq miles. Some of these records have been maintained for more than twenty-five years. In addition to the continuous records of discharge, there are hundreds of isolated determinations of flood-peak discharge.

The first step might be a statistical analysis of the records leading to generalized relations between frequent and rare discharges. These relations might be correlated on the basis of such drainage-area characteristics as size, average width, average slope, and so on.

Since millions of dollars will be spent on new highways after the war, it would seem only logical for the various agencies concerned to spend a few thousand dollars in compiling and analyzing the data that have become available since the early formulas were devised.

GORDON R. WILLIAMS, Assoc. M. Am. Soc. C.E.
Syracuse, N.Y.

Report on Postwar Construction—Criticism and Reply

Matters of Society policy are subject to comment by members, either favorable or critical, but with the provision that the official or committee concerned has the privilege or responsibility of replying. And when the comments are deemed suitable for publicity, the question and the rejoinder are to be printed in parallel. In the present instance objections on the part of several members in Knoxville, Tenn., to the statement on Postwar Construction (September issue, page 439) are met by the chairman of the Society committee which submitted the original statement. In this manner both sides of the matter under discussion may be viewed simultaneously.

DEAR SIR: We have read the policy on postwar construction proposed by the Committee on Postwar Construction of the A.S.C.E. and adopted by the Board of Direction. The Committe has evidently given considerable thought to the subject and has prepared a fairly comprehensive report. There is little fault to find with most of this report as it proposes remedies for a postwar depression which are obviously sound. However, the report is misleading in some respects because of the emphasis given to certain aspects of the problem.

The report places the chief emphasis on public works, although it states that "industrial construction and private housing account for approximately two-thirds of all construction activities." It would seem that more emphasis could have been placed on this phase of the problem in the formation of more definite plans to encourage private enterprise. It seems to be assumed that private construction and housing will solve its own problems.

There is a definite bias against federal public works as compared with state and local public works. In the latter category, mention is made of a number of projects which, although having practical utility, are economically sound only if the intangible factors are highly valued. The proposal that local improvements be financed through the planning stage by federal revolving fund seems to have considerable merit.

The space allotted to a discussion of federal public works is quite small and raises a question of basic policy. There is probably no quarrel with the proposed requirement that such projects have practical utility and be economically sound. The economics of any project may depend largely, however, upon intangible factors which are difficult to evaluate in economic terms.

The second criterion, however, that of not competing with facilities provided through private enterprise, is at variance with our established public policy. Literally followed out, this would eliminate all public roads, canals, schools, airports, hospitals, and other works which do, in fact, compete with private enterprise. In the field of transportation, for example, the government has been competing with private enterprise throughout our history. Toll roads have been replaced by public highways and federally aided canals. The business enjoyed by the private operators of canal boats was in turn interfered with by government subsidies to railroads. In their turn the railroads have lost business to truck lines operating on government built highways and in part to government built and operated waterways. In general, whenever the welfare of the country could be served by a new form of transportation that required government aid for financing, such governmental support has always been obtained, even though it provided competition with other facilities provided through private enterprise. This seems to be fundamental to our form of government.

The growth of this policy into the irrigation of public lands and the development of the resources of our large rivers is logical and inevitable. It will continue in spite of the effort of private interests to maintain control of natural resources and services having a public interest. The Board of Direction of the American Society of Civil Engineers has, by the adoption of this recommendation, placed itself on record as being opposed to a continuance of the federal development of our country's resources.

The report is misleading in that it implies that it has been approved by all the members of the Society. We refer to the following three sentences which are found in the second paragraph of the report: "The American Society of Civil Engineers is over ninety years old, is composed of 19,000 members united in support of the highest professional ethics and sound engineering practices. They serve in industry, in consulting practice, and in engineering departments of federal, state, and local governments with widespread geographical distribution. The Society now dedicates itself to the furtherance of the objectives here presented." Any reader of these sentences, not familiar with the method by which this proposal was adopted, would assume that it had sought and received the support of most all of the members of the Society, including those employed by the various governmental organizations. This has not been done. We object to the wording of the report in this sense and believe that the Board of Direction should correct this. As the national organization representing civil engineers, the Society cannot afford to promulgate resolutions or recommendations which may not reflect the views of its membership. Practices like this, if continued, will eventually endanger the strength of the Society by promoting internal dissension.

G. H. HICKOX
C. W. OKEY
A. S. FRY
R. A. MONROE
HARRY A. WIERSEMA
All Members Am. Soc. C.E.

Knoxville, Tenn.

TO THE EDITOR: As chairman of the Society's Committee on Postwar Construction, I would like to comment on the communication of the five Knoxville members.

Our committee was fully aware when we accepted appointment that the task of preparing a statement of policy on postwar construction would not be an easy one. We appreciated our responsibility and attempted to formulate a sound statement of policy with due regard for those responsibilities. The committee spent many hours of labor in the preparation of the statement. Not only did we utilize the resources of our membership, but we sought and received the advice and counsel of a number of outstanding men in the Federal service, in private industry, and in other professional societies. Much valuable counsel was given to the committee by those men, who gave their time to advise and analyze the problem at hand.

Referring to what I interpret as the key thoughts in the letter in question:

The statement, in paragraph 1, that "there is little fault to find with most of the report . . . " is the source of considerable satisfaction. It is a tribute to the thoroughness of the committee's work and proof that, in general, the ideas proposed are basically good. To hope that a broad statement of policy proposed by a great engineering Society such as ours should, in toto, receive the unanimous approval of the entire membership is rather too much to expect. If the ideas are "obviously sound," however, the work of the committee is worth while.

Paragraph 2 advocates great stress on "formation of more definite principles to encourage private enterprise." Perhaps the committee was at fault in not dwelling at greater length upon this phase of the program. Much effective planning is being done by private industry itself, particularly the work of the Committee for Economic Development. Our committee felt that its efforts should be more pointedly directed to what seems at the moment to be the strategic link in the chain of affairs—the local community, which can be further interpreted as being the municipality, county, and state units. It was not intended to minimize the importance of the private effort, for without successful private effort it seems unlikely that a postwar depression can be avoided. In the field of private housing much constructive work is being done by the National Association of Home Builders of the United States and similar groups working in that particular field.

As to paragraph 3, the proposal that local improvements be financed through the planning stage by a Federal revolving fund is made because the committee feels there are instances where local communities, for reasons of legislative restrictions or other difficulties, will not be able to bring their planning to a successful conclusion in sufficient time to meet the emergency. It was stressed that wherever local enterprise is able to perform such service without Federal assistance this should be done.

In paragraph 4, dealing with Federal public works, it hardly seems that engineers could question the requirement that Federal projects should be practical, useful, and economically sound. These criteria seem fundamental in any engineering approach. The committee is fully aware that intangible factors often enter into the analysis of such problems, and the weighing of these intangible factors is one of the engineering services upon which the public must rely, whether the project be private or Federal. I think it can safely be said that in the great majority of cases, engineers have commendably weighed these intangible factors.

According to the fifth paragraph, "the second criterion, however, that of not competing with facilities through private enterprise, is at variance with our established public policy." I must question this statement. Neither I nor the committee nor, I believe, do the great majority of our membership agree that a Federal public policy of direct competition with private enterprise has been established. The committee is fully cognizant of the many services the Federal Government performs, and of the need of these services. Nor does it propose that these established and proved policies be abandoned. In the opinion of the committee, however, as long as we continue to adhere to our accepted principles of government, our Society could hardly propose a broad statement of policy advocating that the Federal Government should, without question, enter into all fields of endeavor and compete with its own citizenry in providing whatever services this or that group might wish to have performed. No Federal official appearing before the committee advocated such a policy.

Paragraph 6 claims that the Board has "placed itself on record as being opposed to a continuance of the Federal development of our country's resources." I cannot hold the view that there was any declaration on this point, either for or against Federal development of natural resources. If, however, public needs shall warrant additional Federal development of our natural resources, such development can very properly be made in a way not to duplicate or destroy such facilities as may already be in existence. The need for such Federal development should be clearly established by our democratic processes, however, and should not be merely an assumption of the need by those directly interested.

As to paragraph 7, analyzing the method by which the statement of policy is put forth, it is not within the province or the ability of this committee to analyze the constitutional procedure in use by the Society; but it is to be assumed that the Board, in announcing such a policy, has utilized the authority delegated to it by the constitution of the Society. May I say that this committee would not submit to the Board, for its adoption, a statement of policy such as this, without the sincere conviction that it expressed the views of the majority of the membership of the Society.

In conclusion, may I quote from the last paragraph of the statement of policy: "The American Society of Civil Engineers submits this program for the purpose of stimulating clear and practical thinking and constructive action on postwar construction." It is my belief and the belief of the committee that the policy proposed is essentially sound, although no claim is made that it is perfect, or that it is not subject to constructive criticism. If clear and practical thinking can be inspired by the pronouncement of this policy, it will have served its purpose.

G. Donald Kennedy, M. Am. Soc. C. E.
Chairman, Committee on Postwar Construction

Washington, D.C.

Error in Nomograph

To the Editor: In connection with my article on "A Nomograph for the Integration of Stream-Flow Records," in the October issue, I should like to point out that, when the nomograph was redrafted for Fig. 1, an error was made which will doubtless confuse the reader.

It is essential that the center scale be exactly half way between the outer scales. However, in the published form of the nomograph the center scale is substantially closer to the time scale, which makes it impossible to get even approximate results.

Paul B. Johnson

Glendora Calif.

Engineers and Blacksmiths!

To the Editor: Recently in driving through one of the larger cities of the country in which I am now stationed, I noticed on a certain building a firm name which impressed me as being of possible interest to the professional and ethical committees of the Society. In fact, I stopped to take the enclosed snapshot. In

"Engineer" an Elastic Word in Some Parts of the World

this particular instance it is pleasing to note that in the title, "Engineers and Blacksmiths," engineers are named first. In many other signs in similar communities engineers do not have this precedence.

Although we have Engineering Institutes over here, the term "Engineer" seems to cover and denote many more trades than it does in the United States.

Edward S. Bres, M. Am. Soc. C.E.
Colonel, Corps of Engineers, U.S. Army; Office of the Engineer

c/o Postmaster
San Francisco, Calif.

Reinforcing Concrete with Native Cane

Dear Sir: In Professor Glenn's article, "Native Cane Reinforcement in Concrete," in the August issue, he says that the tension specimens of cane always broke at the joint, when there was a joint. One would justifiably infer from this that the strain under all stresses would be greater at the joint and, if so, that the modulus of elasticity would be greater between joints than at a joint. Professor Glenn did not tell whether he got his variation in E by testing at a joint as well as by testing between joints. It seems to the writer that it is important that E at the joint be known.

Judging from the photographs, it would seem that the horizontal cracks were caused by wedging induced by bond failure between the cane and the concrete or by expansion of the cane due to absorption of moisture. Possibly, however it may have been caused by a combination of the two.

In reference to the failure in the slabs, the author says, "There were no diagonal shear cracks in the slab near the support." It is assumed that he meant diagonal tension cracks, for while the diagonal crack is induced by shear it is as a matter of fact actually a tension crack.

F. N. Menefee, M. Am. Soc. C.E.
Professor Engineering Mechanics, University of Michigan

Ann Arbor, Mich.

Specifications Need Intelligent Interpretation

TO THE EDITOR: Reading Mr. Retz's article, in the October issue, must bring back floods of memories to older members like myself. What a blessing it would be if all specifications were concise, comprehensive, and as brief as possible.

But even if they were, another exasperating feature would remain—that is, inspectors who often are too ignorant or inexperienced to know when some detail of specifications should not be enforced, whereas an experienced engineer would know at once that under certain conditions they should not be enforced. In pile driving, for instance, there are cases where pile after pile has been driven to destruction.

Fifty to sixty years ago the two best specifications for bridges were those of Charles Conrad Schneider (President of the Society in 1905) and Theodore Cooper. A small city once received bids from a number of small highway bridge companies, who were supposed to have made their designs in accordance with Cooper's specifications. Cooper was retained to check the plans, and he reported that not a single one of the plans was designed strictly according to his specifications. So the city engaged him to design the bridge. The bridge companies then informed the city that Cooper had not lived up to his own specifications.

Cooper, in despair, asked the bigger bridge companies to send an engineer to explain to the city fathers that, while it was necessary for the highway bridge companies to live up to his specifications, it was not necessary for him to follow strictly his own specifications. He said that his specifications were intended for those who did not know enough to write their own specifications and that he himself did not need any specifications.

Fifty-six years ago I saw the specifications for a particular bridge in the handwriting of, and signed by, the chief engineer of a railroad (typewriters were not common then). The specifications puzzled us until we read: "l = length in square inches," which was a misprint in one of Cooper's specifications, which the chief engineer had copied verbatim.

Schneider, whom I consider the greatest bridge designer of his time, once asked Cooper how he arrived at his adequate formula for spacing stiffeners in a plate girder. Cooper replied that his common sense told him how far apart the stiffeners should be placed, so he had evolved a formula to agree with those results.

Before going to work for Mr. Schneider, then chief engineer of the Pencoyd Bridge Company, I had calculated the deflection of half a dozen draw bridges, when swung open, by a very tedious formula that involved every member of the truss. One day I showed my calculations to Mr. Schneider, who said that he had a better rule than that; he simply allowed $^1/_8$ in. for each 10 ft of span, which gave the same results that I had obtained after hours of work. This was a case where he had discovered a simple rule, which was far better than the specifications formula.

T. KENNARD THOMSON, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

Binding of Old and New Concrete

DEAR SIR: In the August issue of CIVIL ENGINEERING, I was interested to note a letter by Walter F. Shaw stating that a perfect bond between new and old concrete could be obtained by treating the old concrete with dilute hydrochloric acid. This seems to be a very simple solution to a difficult problem and, in the experience of the writer, is far from the answer.

The bond between new and old concrete is affected by many factors, such as shrinkage stresses, temperature stresses, and the presence of surface dirt or foreign matter which would tend to cause a plane of cleavage between the two layers. Hydrochloric acid is beneficial in removing the cement coating with which it reacts chemically. The acid may, however, also react with the aggregate, as is the case if the aggregate is limestone.

To secure a minimum of stress between the two layers (the old and the new), three things are essential: (1) that the temperature of the old concrete and the new be approximately the same when setting is taking place; (2) that the old concrete be fully expanded by saturation before the new is applied, so that when the new concrete shrinks the old will shrink along with it; and (3) that the new concrete have about the same potential shrinkage that the old concrete had originally (and still has even though old). This potential shrinkage is controlled by the amount of cement in the mass and the water-cement ratio (see curves developed by the writer in Urquhart's Civil Engineering Handbook, page 567). Placing a film of grout on top of the old concrete has often been

FEATHER-EDGE CONTACT PRODUCED WITHOUT SEPARATION OR CRACKING ON CONCRETE FLOOR AT NORTHWESTERN UNIVERSITY
Dark Line at Lower Right Edge of Patch Is Caused by Reflection of Original Glazed Surface

used in an effort to insure a good bond at the point of contact. However, this method seems to have the objection that it leaves a film of water on the surface of the old concrete, which tends to keep the cement particles from adhering to the old surface.

Two methods of overcoming this difficulty have been found. One of these is to saturate the old concrete and then sweep off all the excess water, after which the top is sprinkled with dry cement powder. The suction of the dry cement as it absorbs the water tends to draw the cement into the pores of the old concrete and eliminate water and air pockets. The new concrete is then placed directly upon the dry cement.

The second method is equally successful and, as is the case when the first method is used, permits the joining of a thin slab of concrete tapered to a feather edge to the old surface. This method consists of scrubbing the cement into the old concrete surface with a steel wire or fiber brush. The rubbing of the cement into the pores of the old concrete insures intimate contact between the two surfaces.

The accompanying photograph was taken in the basement of the Technological Institute of Northwestern University, where the latter method was employed. The patch coat was placed about five months after the original floor was laid. There is no separation between the two layers.

M. B. LAGAARD, M. Am. Soc. C.E.
Assistant Professor of Civil Engineering
Northwestern University

Evanston, Ill.

Defining Hydraulics—Question and Answer

TO THE EDITOR: I am trying to obtain a clear-cut definition of the word "hydraulics."

The 1943 edition of the *Encyclopedia Americana* defines it as that branch of science that deals with "liquids," etc. The *Unabridged Webster's Dictionary* defines it as dealing with "fluids," etc.

Now fluids include both liquids and gases; and it is not my impression that hydraulics covers gases as well as liquids. I understand that the study of gases would come under pneumatics only. Please give me a short definition of hydraulics stating whether it covers both liquids and gases or just liquids.

CHARLES L. JOYNER
Machinery Drafting Department,
Wainwright Shipyard

Panama City, Fla.

TO THE EDITOR: Answering Mr. Joyner's inquiry, may I say, in the first place, that "hydraulics" very definitely deals with "liquids" only. One of the clearest and best definitions in the English language is found in A. H. Gibson's *Hydraulics* (London.

1934). Starting with an allusion to hydromechanics as "the science which deals with liquids at rest and in motion," Gibson continues that "the term 'hydraulics' is usually broadly applied to that portion which deals with the motion of water in so far as it is of importance in the problems brought directly under the notice of the engineer."

More recently the theoretical and experimental knowledge of fluid flow has been assembled under the name of "mechanics of fluids." "Fluid" is a generic term, which covers both liquids and gases. "Fluid mechanics" proceeds on the premise that identical dynamic laws govern the motion of all fluids.

In a broader sense, fluid mechanics is taken to cover gases and liquids under all circumstances. In a somewhat restricted sense it refers principally to the dynamics of fluids of constant density. Liquids, being practically incompressible, come under this qualification automatically. As to gases, it has been found that within a wide range of practical circumstances, such as encountered for example in aeronautics, the eventual change of density is small enough to be neglected. Under this assumption, present-day fluid mechanics has built up an imposing and useful body of knowledge, equally applicable to water in hydraulic problems and to air in aeronautical engineering.

Whenever the problems are of a kind such that the compressibility of the gas and the eventual changes of density enter into the picture, it is necessary to take into account the thermal aspects, connected with the compression and expansion of gases, as studied in thermodynamics. The treatment in these cases becomes thermodynamical, it being customary lately to assemble the respective analysis under the special heading of "dynamics of gases."

Trusting that these explanations may be helpful, I am,

BORIS A. BAKHMETEFF, M. Am. Soc. C.E.
Chairman, Executive Committee, Hydraulics Division

New York, N.Y.

Specifications and Inspection

DEAR SIR: I was very interested in Mr. Retz's article on specifications, which appeared in the October CIVIL ENGINEERING. There is no doubt in my mind as to the necessity of both specifications and inspection. However, both the specification writer and the inspector could render better services if they had a better understanding of each other's position.

In many cases specifications are written, or compiled, by a man with high ideals as to what a job should be like, but with little regard as to the cost of such a job. Therefore, he specifies the very best in methods and materials. His superior approves these specifications with the thought that the job will be ideal if the specification requirements are met. The contractor bidding the job knows that he cannot get the job if his bid is high enough to cover the expenses required by the specifications, so he submits a competitive bid, depending on his ability to obtain a release from the more stringent requirements.

After all this has taken place, the contract is let and an inspector is hired to see that the contract requirements are met. Quite frequently the inspector's pay will be little, if at all, higher than that of the contractor's laborers. The workmen know this and build up a certain contempt for the man, on the premise that if he had any ambition he would get a better paying job.

If the inspector tries to enforce every detail of the specifications, the contractor will immediately brand him as unreasonable and appeal to his superior for more latitude in his contract. He will likely propose somewhat cheaper methods of doing the job, which sound plausible at the moment. He may first mention this alternative to the inspector, and if he is refused he will proceed to mention it to each of the inspector's superiors until he finds someone up the line who will agree to it. Once this is done, he can proceed as if the inspector were not present. It takes only one weak link in an engineering organization to make such practice possible.

It is quite possible that in the end the job will be very nearly as good as the one specified, and completed at much lower cost to the contractor. However, the job would have been much more satisfactory and could probably have been completed with less cost to the owner, if the specifications had included only those details which were essential to the job, and for which the owner was willing to pay a premium. In short, the specifications should be written for the minimum acceptable job, rather than the maximum desirable one. In addition, money should be provided for ample and competent inspection. After all, the owner buys expensive help for the contractor in his contract price, and it is false economy to protect this investment with cheap engineering or inspection. It takes years to train good inspectors, and it is impossible to get them if they can be attracted to more lucrative occupations. Poor inspection is often worse than none at all, since the inspector's presence tends to relieve the contractor of responsibility for the quality of the work.

GORDON L. WILLIAMS, Assoc. M. Am. Soc. C.E.

Welch Cove, N.C.

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

Currently Dr. Mead gives his answer to Question No. 14 which was announced in the September issue of "Civil Engineering." The question states that "An engineer in general practice was retained by a client to prepare plans, estimates, and specifications, and to inspect and superintend the construction of certain works. In this capacity the engineer became the interpreter and arbiter of the contract and specifications. The contractor who had taken the contract, realizing the experience and ability of the engineer in his specialty, desired to employ him at the same time on another project of a similar nature which he had in view. The engineer had ample time for both jobs. Should he have accepted or rejected the contractor's offer?"

The client of an engineer, except by special agreement, has no proprietary right in the engineering plans for work which is being done and, unless otherwise specifically agreed, cannot use such plans the second time without additional compensation to the engineer who has produced them. The engineer therefore has a right to use such plans and details for other clients whenever he so desires.

It should be remembered, however, that the same plans in detail are seldom entirely satisfactory for any two locations and should therefore always be made with the conditions of the installation carefully in mind. In almost sixty years of engineering experience, the writer cannot remember that he ever used the same plans twice, although he has built many plants similar in nature. However, he has always found it necessary to make radical changes to fit the particular work for which the plans were made.

DANIEL W. MEAD, Past-President and Hon. M. Am. Soc. C.E.

Madison, Wis.

In the fifteen questions on ethics which have been published in CIVIL ENGINEERING during the past fifteen months, Dr. Mead has attempted to select so far as possible questions which were fairly close to the border line, and could be answered definitely only by fairly close definition of the circumstances prevailing in any particular case.

For No. 16 of the series, he is submitting a problem which he believes can hardly be called a question as the answer will be immediately apparent to most engineers. However, he has been advised by a personal friend (who is conducting a class on the subject of ethics in one of the state universities) that many of his students appear to think that, because such conditions are not entirely uncommon, the action of the engineer in the case may be considered as satisfactory. Dr. Mead therefore submits one of these problems in the hope that it may elicit discussion on the subject. Discussion may be submitted until December 5, with answers in the January issue.

PROBLEM NO. 16: *An engineer in charge of design and construction of a large plant feels that his employers do not correctly interpret his contract with reference to compensation and they refuse to pay what he thinks are his just dues under the contract. He enters into an agreement with his employers' contractor to pad the quantities. This results in the contractor's receiving overpayments which extra sum he turns over to the engineer as compensation. What is the ethics of this situation?*

SOCIETY AFFAIRS

Official and Semi-Official

Collective Bargaining for Professional Engineers

Report of the Society's Committee on Employment Conditions as Presented to, and Adopted by, the Board of Direction at Its Atlanta Meeting, October 11, 1943

THE BOARD OF DIRECTION
AMERICAN SOCIETY OF CIVIL ENGINEERS

Gentlemen:

The Committee on Employment Conditions places before you, with its recommendation for adoption, a proposal that at first consideration you may deem unusual. However, it believes that thoughtful consideration of the proposal will disclose its merit.

The Committee met in Albuquerque, N.Mex., September 11, 12, 1943, with all members present. Mr. George T. Seabury, Secretary of the Society, and Mr. Howard Peckworth, Assistant to the Secretary, also were present and participated in the deliberations of the Committee.

The Committee members agree unanimously that the most important factor influencing the present and future welfare of professional engineers, and particularly those engaged in the civil engineering field, including the members of the American Society of Civil Engineers, is collective bargaining as provided for by national and, in some cases, state legislation.

Collective bargaining is with us and will remain indefinitely. There is good reason to believe that the application of collective bargaining will be widened and that in the near future all employees, regardless of occupation, will be forced to adopt collective bargaining group procedures in one form or another.

If the professionally minded engineer is not prepared to bargain collectively through representatives of his own choosing, collective bargaining will be done for him by representatives selected by an organization with which he may not wish to be identified. It is probable that not less than 90% of the membership of the Society would come under the classification of employees and that sooner or later, under the provisions of the National Labor Relations Act, these engineers will be forced unwillingly, unless something is done to protect them, into organizations which will assume bargaining powers for them.

In fact, it is believed that unless the professionally minded employees within our membership, and others, are identified with organizations of their own choosing, formed especially for collective bargaining purposes, such collective bargaining will be assumed by units composed largely of sub-professional and nonprofessional persons, and related to the manual trades.

The Committee on Employment Conditions is extremely conscious of the gravity of this situation as it affects the Society and its membership. The Committee believes, moreover, that the time has arrived when the Society must perform this economic function for its membership as well as those of an educational, scientific and technological nature. We believe we are fully aware of the meaning of this step and its implications, but if the professionally minded civil engineer is to maintain his identity as such, this action is imperative.

The Committee on Employment Conditions recommends, therefore, that the American Society of Civil Engineers institute collective bargaining facilities for civil engineers. In order to accomplish this function, the Committee recommends the adoption of the following three-phase program by the Board of Direction as necessary in order to implement that objective: It is proposed (1) that the Constitutions of the Local Sections of the Society be amended to establish within them bargaining groups each in its own area, (2) that assistance be given those groups by the employment of four field representatives, one to be operative in each of the four Zones, and (3) that an adequate definition of professionally minded employees be adopted as the basis for the collective bargaining groups proposed.

(1) EACH LOCAL SECTION TO PROVIDE FOR A COLLECTIVE BARGAINING AGENCY

In conformity with federal legislation, collective bargaining units must be local in character although these locals may be affiliated with one another through a national coordinating agency. It is therefore impracticable for the Society to attempt to establish itself as a national collective bargaining agency but it may act as the coordinating agency for such local collective bargaining groups as are established and it may render them guidance and financial support.

Each Local Section, therefore, to act as a focal point through which to carry out the function of a collective bargaining group, should amend its constitution, according to required Society procedure, to establish a local "Committee on Employment Conditions," using the phraseology indicated later herein.

The Constitution of the Society, Article I, Section 3, sets forth as one of the objects of the Society, "the professional improvement of its members." Also in Article IX the Constitution describes the functions of the Local Sections to be "the encouragement of members to . . . confer and suggest as to matters of policy, to study local engineering problems . . . and to bring about . . . a spirit of cooperation between the engineers in a community."

These words are deemed to be sufficient to include the newly proposed activity and no other expressions in the Constitution are considered to prevent the newly proposed activity. Thus, it appears there will be no inconsistency with the Constitution and no need for its amendment.

The By-Laws of the Society, also, it is believed, express no restriction that would prevent the institution of the newly proposed activity, nor, it is believed, do the present terms of the Local Section constitutions.

Therefore, it is RECOMMENDED that the Board of Direction recommend to each Local Section that it amend its Constitution as follows:

Committee on Employment Conditions

Add Article:

Section I. There shall be a standing committee to be known as the Committee on Employment Conditions. Such committee shall consist, for the years 1944, 1945, and 1946, of three members of the Local Section, each to be elected for a term of three years, except at the start; one member to retire each year. The committee shall elect from its membership a chairman, a vice-chairman and a secretary-treasurer, each of whose terms of office shall be for one year, and each of whom may be re-elected so long as he remains a member of the committee. Each member of the committee may succeed himself for one consecutive term of three years. All members of the committee shall be "Professional Engineering Employees" within the meaning of that term as defined by the Board of Direction of the Society.

Section II. The members of the Committee shall be elected annually by letter-ballot from those Professional Engineering Employees, as shall be determined by the Board of Directors of the Local Section, who, as members of the Section, have paid the dues stipulated for them in Section VI of this Article, and those non-members of the Section who have paid the dues stipulated for them in Section VI to the financial support of the Committee. Vacancies in the Committee's membership shall be filled similarly by letter-ballot as occasion may require. The names of candidates for election to the Committee, at either the regular time for election or to fill a vacancy, shall be placed on the ballot for election, by nomination from the floor at the time of the Section's annual meeting or upon the written

request, previously received by the Secretary of the Section, of ten Professional Engineering Employee non-members of the Local Section. Canvass of ballots and declaration of election shall be made by the Board of Directors of the Section not less than ten days after date of issue of the ballot. Following the year 1946, members of the Committee on Employment Conditions may be of those non-members of the Local Section who have paid the dues stipulated for them in Section VI.

Section III. The Committee shall hold meetings at such times and places as are necessary for the transaction of its business. It shall keep a record of all its proceedings. It shall hold a public annual meeting at the time of the annual meeting of the Local Section for the purpose of making and filing reports, including a public report of its receipts and expenditures and their sources and purposes, and for the transaction of such other business as properly may come before it.

Section IV. The Committee shall have the duty and the power to direct all activities looking towards the acquisition of adequate compensation and satisfactory working conditions for all Professional Engineering Employees resident within the geographical limits of the Local Section and shall represent them in compliance with and pertaining to any laws, relating to such matters, of the United States, or of the State or States as lie, in whole or in part, within the boundaries of the Local Sections. The Committee shall administer its functions in accordance with the general direction of those Professional Engineering Employees who have paid the dues stipulated in Section VI.

Section V. When the Committee shall act as collective bargaining agent with respect to any certain employer, any member of the Committee who shall have a direct interest in the outcome of the bargaining shall withdraw from participation in that bargaining procedure and the Committee shall select and designate another Professional Engineering Employee to act as his alternate in that bargaining procedure.

Section VI. The expenses of the Committee shall be defrayed by dues of \$* per year collected by the secretary-treasurer of the Committee from those Professional Engineering Employees who are members of the Section and by dues of \$** per year similarly collected from those who are non-members of the Section, resident within the Local Section area, who wish to be represented by the Committee and have been determined by the Board of Directors of the Section to be Professional Engineering Employees.

\$* Preferably not to exceed \$1.00 annually, except as emergencies may require.

\$** Preferably not to exceed \$5.00 annually, except as emergencies may require.

It is recognized that this suggested amendment probably will not be fully satisfactory to all Local Sections in all of its details, but until experience demonstrates better details it will serve to express the basic principles deemed desirable.

It is RECOMMENDED that the Board recommend to each Local Section that it amend its Constitution as indicated.

(2) Field Representatives

It is the Committee's belief that a sincere and effective effort in this matter of collective bargaining will not be of material value unless the Local Section Committees on Employment Conditions shall have the frequent aid of a man, alert to and conversant with the unsatisfactory employment conditions that undoubtedly will arise in a given area. His experience and advice will be invaluable and upon occasion his personal efforts in conciliation may be far more valuable than any formal collective bargaining procedure. It seems desirable that four such men be engaged, to be operative, for the present at least, one in each of the Society's Zones.

These representatives must be "hand-picked" and must possess certain special talents necessary for the proper discharge of their duties. Their duties and functions would be to assist and advise with the various Local Section committees, as provided for in the foregoing amendment to the Local Section Constitutions, on all matters concerning collective bargaining; to organize, if necessary, and to assist professional civil engineer employee groups; to work with and advise members concerning collective bargaining organizations; to address and advise with student groups and undergraduates in engineering schools with a view toward making prospective engineers professionally minded. They may also very properly interview and advise non-members who seemingly are eligible for Society membership and, in general, expand the influence of the Society.

The cost to the Society of maintaining four special field representatives to function under the direction of the Secretary may not be minimized. The Committee visualizes that the salaries, travel, legal advice, and other facilities required will approximate \$50,000 per year for the four new men required.

It is the belief of the Committee, however, that such an amount is really nominal compared with the benefits and objectives to be accomplished and, were the cost of such a program to be much greater, the Committee believes it would still be a justifiable expense to be borne by the Society. The professional civil engineer must maintain his identity as such and remain in professional status.

It is RECOMMENDED that the Board approve the employment of four Field Representatives and appropriate the sum of \$50,000 per annum for the expenses that thus properly may be incurred.

(3) Definition of "Professional Engineering Employees"

In order that professional civil engineer employee groups be identified and segregated as such under the provisions of the National Labor Relations Act, it is necessary that the professional engineer employee be clearly and precisely defined. In other words, in order that professional engineer employees may form organizations for collective bargaining purposes, the membership of such groups must conform to definite qualifications and characteristics of such nature as will exclude from affiliation with them, persons not having those qualifications and characteristics.

The following definition of "Professional Engineering Employees" is proposed.

> "The designation 'Professional Engineering Employees,' used in the sense that persons capable of being so designated may join with others similarly capable of being so designated for the purposes of collective bargaining separately from any other group composed of persons not capable of being so designated, shall be that of only those who, excepting employers or those to whom employers have delegated managerial responsibility with respect to employment conditions, possessing an intimate knowledge of mathematics and the physical sciences, gained by technological and scientific education, training and experience, and in a position of trust and responsibility, apply their knowledge in controlling and converting forces and materials to use in structures, machines, and products, and whose work requires the exercise of discretion and judgment, is creative and original and of such character that the output cannot be standardized; and those who, without the experience set forth, but having been graduated from an approved educational institution and having received the degree of Bachelor of Science or its equivalent, in Engineering, are engaged in engineering work."

It is RECOMMENDED that the Board approve this definition of "Professional Engineering Employees."

Respectfully submitted,

Committee on Employment Conditions
Ashley G. Classen C. W. Okey
Gail A. Hathaway Richard G. Tyler
A. M. Rawn, *Chairman*

Adopted by the Board of Direction
October 11, 1943
George T. Seabury,
Secretary

In This Issue

Atlanta Entertains

Georgia Section Sponsors Fall Meeting That Takes Place of Regular Society Conclave

IN LINE with Society policy to cut down transportation to meetings, no official Fall Meeting was scheduled for 1943. Instead, a meeting of the Georgia Section, held in Atlanta, filled the need. It provided the locale and the occasion for such activities as are deemed essential to war success, notably the regular Board meeting and the Local Sections Conference.

In spite of this necessarily localized aspect, the meeting in Atlanta on October 12–14 filled several important functions of a Society Fall Meeting. It furnished a program of fine technical content and provided the occasion for nearby engineers to congregate for enlightenment and sociability. Except for those present primarily on national Society business, those who attended came almost exclusively from the Southeast. The combination was a fine one and all elements of the meeting contributed to make it a worth-while gathering.

PROGRAM WAS CONCENTRATED

In one feature the meeting showed the distinction and the advantage of its local color. Only one event was held at a time and thus the interest was unified. And as a result the sessions, the luncheons and dinners, were excellently attended. All gatherings were at the Atlanta Biltmore where facilities were ample to care for even a larger type of meeting. Not that the attendance was insignificant. On the contrary about 300 people in all attended one or more of the events. These included a goodly number of military men and military students, also a fair number of ladies, both from Georgia and further away. Their program was in general separate from that of the men, except for luncheons and evening events.

Three sessions comprised the technical program: two on Wednesday and one on Thursday morning. All were well prepared and of general appeal. At the outset, on Wednesday morning, October 13, following invocation, official welcome, and other formalities, the meeting assumed a national color when President Whitman reviewed briefly important recent Society developments. Then followed a scholarly diagnosis of some current economic trends and the engineer's relation to them.

GEORGIA'S STATE CAPITOL
Atlanta Was Scene of Georgia Section's Fall Meeting, Oct. 12–14

Still dealing with larger technical aspects, the afternoon meeting considered national transportation problems of the postwar period. Four authorities covered this subject, dealing first with the general outline, followed by representative discussions of many of the details as related to railroad, air, and highway transportation. All these men spoke with authority as a result of close familiarity with their subjects, gained by first-hand experience. The large audience was held captivated by this fine program.

LARGE BOMBER PLANT PROVES INTERESTING

A more local problem engaged the sessions on the morning of the following day, Thursday. Thus the attention of the Atlanta sessions was becoming more and more concentrated, progressing from the general to the detailed. The specific general subject of this last session was the nearby (Marietta) aircraft assembly plant, locally known as the Bell Bomber Plant. The huge main building is one of the largest in the current national program. Other power, accessory, and service buildings are also notable. The three features especially covered were construction, design, and transportation.

No attempt can be made here to do more than refer to the fine technical addresses made throughout the meeting. Much interest was shown not only in listening to the presentations, but in seeing them in print. It is hoped that generous selections may be made from many if not all of these papers for use in CIVIL ENGINEERING. Several fine displays of models, photographs, and materials were also on view in the meeting hall.

Special point was given to the descriptions of the Bell Bomber Plant by the inspection trips scheduled for the same afternoon, Thursday. After an early lunch three trolley cars took off for an hour's ride to Marietta. Wartime restrictions prevented more than a view of the exterior of the plant, contrary to earlier expectations; and this constituted a major disappointment. However, the view permitted was most impressive, encouraging belief in the almost astronomical figures quoted by the engineers in charge.

En route back to Atlanta, each car stopped to permit an hour or more of inspection of a different city facility. One went to the incinerator, one to the disposal plant, and the third to the water works. These visits, with their opportunity for sociability en route, made a fine conclusion to the Atlanta meeting.

SOCIAL AND TECHNICAL SIDES COMBINED TO ADVANTAGE

It was significant of the spirit of the program that even the social events had their serious side. Those at the luncheon on Wednesday were privileged to listen to a fine talk on postwar planning. That evening the main speech after the dinner and before the dancing was on engineering economics. A gage of the interest in this, the main social event, was the attendance of over 200.

Purely social was the Tuesday evening dinner given by the local group for the Board members, Local Section delegates, and their ladies. This was a jovial, informal program, featuring a reception, a splendid buffet supper, and excellent negro music following.

For the record it should be mentioned that activities of one sort or another were continuous from Sunday noon, when the Board committees began to function, until the very end. The Board itself met all day Monday and on Tuesday morning. Some of the highlights of its significant actions are given in these pages in the abstract of its minutes. All day Tuesday, October 12, delegates from about 24 Local Sections east of the Mississippi sat around a table to exchange experiences in their Society work. The give and take of engineering discussion proved both helpful and inspiring.

Many members of the Georgia Section, under Paul Weir, its president, devoted a great deal of time and effort to ensure the success of this meeting. Doubtless the Section itself was the greatest gainer from the challenging program. Yet appreciation and sincere thanks must be recorded as expressed by the others attending. The vote of appreciation by the Board was expressive also of the widespread gratitude felt by all those who enjoyed this historic meeting.

Meeting of the Board of Direction—Secretary's Abstract

The Board of Direction met at the Atlanta Biltmore, Atlanta, Ga., on Monday and Tuesday, October 11 and 12, 1943, with President Ezra B. Whitman in the chair, and Secretary Seabury and the following members of the Board in attendance: Past-Presidents Fowler and Black; Vice-Presidents Spofford, Stanton, Hastings and Agg; and Directors Bakenhus, Breed, Burpee, Carey, Cunningham, Dickinson, Dougherty, Edwards, Goodrich, Howard, Lilly, Massey, Rawn, Requardt, Scobey, Wiley, and Treasurer Trout. Regrets were received from Directors Boughton, Cowper, and McNew.

Approval of Minutes

Records of the meeting of the Executive Committee on July 27 and 30, 1943, and of the Board on July 28–30, 1943, were approved as written.

Honorary Members

Canvass of ballots disclosed that four new Honorary Members of the Society had been selected, as follows: Edward Hanson Connor, Francis Trenholm Crowe, Thomas Harris MacDonald, Gerard Hendrik Matthes. An item elsewhere in this issue gives further details.

Appointments to Division Executive Committees

Acting upon recommendations of the Divisions, the Board chose new members on the executive committees of the various Divisions to take the places of those members whose terms are to expire in January 1944. A list appears elsewhere in this issue.

Nomination for President

For the information of the Board, the Nominating Committee reported the choice of President of the Society for 1944 as Malcolm Pirnie, M. Am. Soc. C.E., of New York, N.Y. Subsequently his acceptance of this nomination was reported. An item on another page refers further to this matter.

Society Prize Winners, 1943

Confirming the selection of the Committee on Society Prizes, the Board provided for these awards, as noted in detail in a separate item in this issue.

The Construction Engineering Prize, under the auspices of the Construction Division, and the Karl Emil Hilgard Prize under the Hydraulics Division, were also certified, as mentioned separately elsewhere in these pages.

Alfred Noble Prize

Report was received from the Alfred Noble Joint Prize Committee. The Board acceded in confirming this award to Benjamin J. Lazan, of the American Society of Mechanical Engineers, for his paper entitled "Some Mechanical Problems, etc." published in the February 1943 issue of Transactions of the American Society of Mechanical Engineers.

Canceling Dues on Account of Military Service

Following previous policy, it was decided that 1944 dues will be canceled automatically for those members in the armed forces of the United States in non-commissioned status; also, upon request, for commissioned officers receiving base pay of $2,400 or less. All these will continue to be listed as members and have prior unpaid dues canceled; and such as are corporate members shall retain their voting rights. Civil Engineering is to be sent to all whose addresses are known.

It was reported that following previous authorization, the 1943 dues of 84 members in the armed services were canceled in the interval between the July and October Board meetings; and by special action, the 1942 and 1943 dues of 80 other members in the armed services, of whose present whereabouts little is known, were canceled and their names placed on the "inactive list." Including such members whose 1943 dues have been canceled, and those on the inactive list, similarly treated, the total was reported as 887 members.

The names of those Juniors in military service who will reach the Constitutional age limit of 35 in 1944, and who have not filed the required application for transfer, were placed on the inactive list.

Dues of Foreign Members

It was decided to continue the previous policy in regard to payment of dues from foreign countries; namely, the sharing by the Society and the foreign members of the unfavorable exchange.

Society and Board Meetings, 1944

It was decided to continue the policy of omitting spring and fall Society meetings next year; and instead to hold meetings of the Board in conjunction with regular meetings of Local Sections, probably somewhat expanded. On this basis a schedule was adopted, comprising a spring meeting of the Board with the St. Louis Section, a summer Society convention at Chicago; and a fall meeting of the Board with the Cleveland Section.

Bequest of John W. Alvord, Honorary Member

It was reported that John W. Alvord, Hon. M. Am. Soc. C.E., who died on July 1, 1943, had named the Society as legatee in his will.

Establishment of J. C. Stevens Award

The Board accepted with appreciation a deed of gift from J. C. Stevens, M. Am. Soc. C.E., for the purpose of financing an annual prize, to be designated the "J. C. Stevens Award." A prize of books costing $50 will be awarded annually for the best discussion of a paper in Transactions in the field of hydraulics, including fluid mechanics and hydrology. Complete details of this new award will be announced in a later issue.

Tax Problems—Engineering Economics Division

Approval was given for the Engineering Economics Division to form a Division committee, to report on the general problems of federal ownership of land, as affecting local tax and administrative matters. This decision of the Board was made on recommendation of the Committee on Division Activities, following a specific inquiry of the Division.

Collective Bargaining Groups

Adopting the report of the Committee on Employment Conditions, the Board voted to recommend to the 64 Local Sections of the Society that they amend their constitutions in regular procedure, so as to provide for collective bargaining groups of employed engineers in their respective areas. A definition of "professional engineering employees" was also adopted. The Board action included authorization of the employment of four additional staff members to be resident in four sections of the country; they are to proffer such guidance as may be advisable in bargaining procedure and, in general, are to advance the several activities of the Society as represented by its publications, its administrative committees, and its adopted procedures. Another item elsewhere in these pages gives the details.

Ammendment to By-Laws—Committee on Employment Conditions

Regular written notice was given anticipating amendment to the Society By-Laws establishing the Committee on Employment Conditions as one of the regular standing committees of the Society.

Report on Salaries

The Board adopted the report of its Committee on Salaries wherein it set forth a "Classification and Compensation Plan for Professional Civil Engineering Organization." This report is to be sent to the Presidents and Secretaries of all Local Sections, but is not to receive general publicity until certain clarifications may be considered in further detail.

Districts and Zones

The Board adopted a recommendation of the Committee on Districts and Zones, whereby such areas are in general to remain unchanged in 1944; except that the definition of Districts and Zones will be in terms of Local Section areas instead of the boundaries previously used.

Various Reports

Many other committees made routine or special reports. Similarly, the Society's representative in Washington, Hal H. Hale, reviewed matters of Society and engineering interest; and Howard F. Peckworth, assistant to the Secretary, reported confidentially on his activities in relation to engineer employment conditions since the previous meeting of the Board.

Other Matters

Various items were presented involving professional or Society activities. After full discussion, appropriate action was taken in each case.

Adjournment

The Board adjourned at noon, October 12, to meet at Society Headquarters on Monday, January 17, 1944.

Malcolm Pirnie Nominated for Society President

The Society's Nominating Committee, meeting in Atlanta, Ga., on October 11, following regular procedure as provided in the Constitution, unanimously selected Malcolm Pirnie of New York City as its choice for President in 1944. Mr. Pirnie thus becomes the official nominee, whose name will appear with others on the final ballot.

Educationally, Mr. Pirnie is a product of New England, with bachelor's and master's degrees in Civil Engineering from Harvard. Professionally, his work has centered for more than thirty years in New York City. Continually during this period he has been in consulting work in the great field of sanitation and water supply. For about five years he was employed by the firm of Hazen and Whipple. Thereafter, for thirteen years more, he was included as a member of the firm under the name of Hazen, Everett, and Pirnie. And for the past fourteen years he has been head of his own firm. In the course of all this work his practice has taken him to many parts of the United States, as well as abroad. Further, his activities in the Society, both as Director and Vice-President, have made him known to many engineers throughout the country. His acquaintance has been broadened during the war.

Comparatively young for this important office, Mr. Pirnie will offer the faculties of a fine mind, an engaging personality, a high standing in the profession, and an intimate knowledge of Society practices and ideals. His name will appear with the other official nominees on the ballot to be canvassed in January. Biographical sketches of all these men will appear in the December issue.

Four New Honorary Members Elected

Final action was taken by the Board of Direction at its October meeting in Atlanta, resulting in the election of additional Honorary Members. The following received this distinction:

Edward Hanson Connor
Francis Trenholm Crowe
Thomas Harris McDonald
Gerard Hendrik Matthes

All have acquired renown through wide experience, each in a different field. Throughout a long career, Mr. Connor has been connected with widespread railroad and construction operations, particularly bridge building, with the Missouri Valley Bridge and Iron Company. He is now consulting engineer and vice-president of this organization. One of the company's largest projects was the substructure of the East Bay section of the San Francisco Bay Bridge. He has been president of the Kansas State Section and served as Director of the Society for the term 1913–1915.

Widely known for his construction exploits in the Far West, Frank Crowe has spent almost forty years in heavy construction work. At first he was with the Reclamation Service, later with the Morrison-Knudsen Company, then with Six Companies, Inc., on Boulder Dam, and succeeding great projects. At present he is construction superintendent of Shasta Dam. He thus stands among the foremost engineers who have succeeded in major construction operations.

It is as a government official that Thomas H. McDonald is best known. Following brief teaching experience at his alma mater, Iowa State College, he served as engineer and chief engineer of the Highway Commission in Iowa. The past twenty-five years have seen his greatest contribution to engineering advancement, as chief executive official of the U.S. Bureau of Public Roads, now the Public Roads Administration. So it has been his privilege to pioneer in the great national development of highways. For this work he has been widely honored. On a number of occasions he has also appeared before technical meetings of the Society and Local Sections.

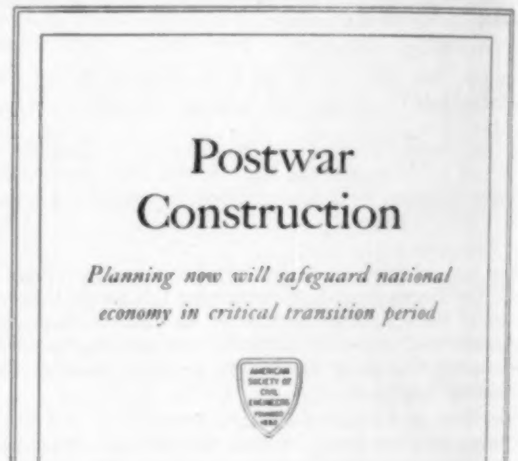
Primarily a scientist and a hydraulician, Gerard H. Matthes enjoyed an early training abroad but his engineering education was American. For about fifty years he has been exercising his great ability largely in the public service, in such organizations as the Miami Conservancy District, U.S. Geological Survey, and the U.S. War Department. Among other subjects, he is considered an authority on navigation, water power, hydraulics, flood control, aerial surveying, and mineral resources. For many years his speciality has been the hydraulics of the Mississippi River, under the Mississippi River Commission. More recently he has been director of the U.S. Waterways Experiment Station at Vicksburg. He has served the Society in many ways; for almost ten years he has been chairman of its Committee on Flood Protection Data.

A more extended appreciation of these notable engineers will be given in a later issue. The presentation of the awards themselves will be a feature of the Society's Annual Meeting in January, and it is hoped that all four of the new Honorary Members will be present on that occasion.

"Postwar Construction" Reprints Available

"Planning for Postwar Construction" was strongly advocated in the plea presented in the September issue. The program and its principles had been prepared by the Society's Committee on Postwar Construction, G. Donald Kennedy, Chairman, and adopted by the Board of Direction. So great has been the demand that it has been necessary to reprint this in more convenient form for distribution, and more attractive appearance for study. The pamphlet is 12 pages, 6 by 9 inches in size and most readable in style. The Society endorsement is obvious so that it is felt this reprint will be most effective in selling its valuable ideas.

The supply has been made sufficient so that any individual who is interested may secure a copy upon request to Headquarters. In addition, if organizations desire larger quantities for their members, copies will be provided and forwarded at cost. It is hoped that this pamphlet will fulfill its worthy purpose of stimulating all sorts of people—engineers, lay citizens, and officials—in thinking more seriously and more effectively toward the ideal of "planning now."


Postwar Construction

Planning now will safeguard national economy in critical transition period

A Program Proposed by
THE BOARD OF DIRECTION
July 29, 1943
American Society of Civil Engineers
33 WEST 39TH STREET, NEW YORK 18, N. Y.

Pamphlet in Handy 6 by 9-In. Size Is Now Available

SOCIETY'S HEADQUARTERS STAFF

Photo Taken on Roof of Engineering Societies Building, October 8, 1943; Rockefeller Center Shows in Far Background

Headquarters Staff Assembles for Photo

SELDOM indeed is the entire staff of the Society's New York office together long enough to have a group photograph taken. Therefore advantage was taken of the opportunity presented on October 8 when practically the whole office force was assembled prior to departures of several for the Atlanta Meeting.

Even in the course of a few months the personnel may change considerably. Such changes are due primarily to marriages, to transfer to war work, and to military service of one sort or another. In spite of such changes, it is remarkable the key members have remained. This fact gives point to the special purpose for which the appended photograph was made—this was primarily so that copies could be enclosed in Christmas boxes to former members of the staff now in military service.

Construction Prize to C. B. Jansen

THIS year the Construction Engineering Prize—given annually for the best original scientific or educational paper on construction published in CIVIL ENGINEERING—goes to Carlton B. Jansen, M. Am. Soc. C.E., for his article entitled "Submerged Shipways with Steel Sheeting Walls—Constructing the Shipways," which appeared in the July issue.

The prize is being awarded for the fifth time, having been established in 1939 through the generosity of A. P. Greensfelder, M. Am. Soc. C.E. It is the only prize specifically limited to material appearing in CIVIL ENGINEERING. Mr. Jansen, who is manager of the general construction department of the Dravo Corporation at Pittsburgh, Pa., will receive the award at the time of the Annual Meeting in January.

John Fritz Medal Goes to Charles F. Kettering

THE John Fritz Medal, which has been referred to as the highest award of the engineering profession, goes this year to a member of the Society, Charles F. Kettering, "for notable achievements in the field of industrial research which have contributed greatly to the welfare of mankind and the nation."

Born in Ohio in 1876, Dr. Kettering was educated in the Wooster (Ohio) Normal School and Ohio State University and is the recipient of many honorary engineering degrees from other universities. His numerous inventions include the Delco starting, lighting, and ignition system for automobiles and the Delco farm-lighting system. In 1916 he established a research laboratory at Dayton, Ohio, and in 1925 moved to Detroit, Mich., where he is vice-president and director of General Motors Corporation and president and director of the General Motors Research Corporation.

The Board of Award consists of four past-presidents of each of the Four Founder Societies. Previous recipients of the Medal, which is devoted to the recognition of distinguished contributions in the field of applied science, include Thomas A. Edison, George W. Goethals, Orville Wright, Guglielmo Marconi, and Herbert Hoover.

Executive Committeemen for Divisions

NEW APPOINTMENTS have been made to the executive committees of the various Divisions by action of the Board of Direction at its Atlanta meeting. According to the By-Laws, it is provided that nominating committees for each Division shall suggest a number of names, from which the Board shall choose one new member for each executive committee. The term is five years.

Following this procedure, new appointees have been made to the executive committees of each of the Divisions, as follows:

DIVISION	APPOINTEE
City Planning	P. L. Brockway
Construction	Clyde W. Wood
Engineering Economics	C. B. Breed
Highway	Gibb Gilchrist (reappointed)
Hydraulics	Calvin V. Davis (reappointed)
Irrigation	M. C. Hinderlider
Power	Arthur T. Larned
Sanitary Engineering	Harry Freeburn
Soil Mechanics and Foundations	George L. Freeman
Structural	F. W. Panhorst
Surveying and Mapping	G. Brooks Earnest
Waterways	Ralph Whitman (reappointed)

All these new appointees take office in January 1944.

To Determine Proprieties in Engineering

MANY ENGINEERS have been following with interest the questions on ethics propounded each month for the last year or two by Dr. Mead. Correspondence with the editors and with the Committee on Publications indicates not only widespread attention to this series, but thoughtful consideration of the basic questions involved.

Purposely the problems have been so stated as to be hypothetical in nature. There has been no intention of pointing an accusing finger at any particular figure or situation. Nevertheless, most if not all the questions have been based on, or suggested by, actual happenings, perhaps in a correlated field. It is the principles rather than the incidents themselves that are in question. The specific cases are only the text for the particular fundamental discussed.

The point is that similar cases arise over and over again in practice. If they are solved successfully, the experience should be helpful to others. If the solution is not clear, the diagnoses or conclusions of other men would be most valuable. In either case the proper procedure would be to send in the comments, of whatever nature, to Headquarters.

For this reason the Committee on Publications is concerned that this department be made of maximum use to the membership. This can only be effected if contributors collaborate. The bringing up of new subjects or the discussion of the questions posed by Dr. Mead are desired. In the end he will give his own version of the proper procedure and if he cannot reach a satisfactory decision, he will admit the fact.

Both border-line and flagrant practices are subject to debate. After all, what may seem obviously good or bad conduct to one person, may not appear in the same light to another. Full discussion will help to clear the air. Members can be of material assistance to Dr. Mead by entering the discussion or by propounding principles. It is hardly fair that he should be left alone to "carry the ball" in this important department.

So send in your ideas—either as discussions of the current questions or as suggestions for new questions. It is understood that specific experiences will be sufficiently masked by Dr. Mead to prevent identification. If his treatment has helped you, it is more than possible that your problems will help others, or be helped by others.

Committee Research Under Way on Soil Testing Methods

Abstracted from Progress Report of Committee on Sampling and Testing of Society's Soil Mechanics and Foundations Division.

Introduction. During the fiscal year ending September 30, 1943, the Committee on Sampling and Testing has organized and initiated work on its second assigned project, "Development of Better Methods of Testing Soils." The Committee realized initially that soil testing equipment and techniques are dependent on the applications of the test results, that improvements in equipment and techniques are largely dependent on correlations of test results with field observations, and consequently, that the field covered by its general assignment is very broad. Therefore, after considerable study, the Committee selected the "Development of Testing Methods for Prediction of Soil Bearing Values" for its initial research. This subject has general importance in foundation engineering in the common problem of footing design and is also directly connected with the problems of airfield pavement design which have confronted our armed forces.

Cooperative Project with Corps of Engineers, U.S. Army. The Office of the Chief of Engineers, U.S. Army, has authorized cooperation between the U.S. Waterways Experiment Station and the Committee in a study of soil bearing values as applied to airfield pavement design and in the development of soil testing methods for prediction of the bearing values, with particular emphasis on the effects of possible future changes in soil moisture content. In this cooperative arrangement, large-scale field tests are performed by the Waterways Experiment Station, and laboratory tests on the same soils are performed by the Committee. After conferences between the Chairman of the Committee and representatives of the Office of the Chief of Engineers and of the Waterways Experiment Station, it was decided that field tests would be made on three soils—a silty clay, a highly plastic clay, and Vicksburg loess, each in both a fairly dry natural condition and in a state closely approaching saturation. Undisturbed samples of these soils in both conditions would be sent to the Committee for its tests.

Development of Portable Sampling and Testing Equipment. To make the results of this study practical for both the airfield pavement design problems of the armed forces and the commonly encountered footing design problems in foundation engineering, the Committee believed that its testing program should include not only tests on, and variations of, existing equipment, such as is found in established soil mechanics laboratories, but also tests on portable equipment which can be used readily in the field. An objective has been to develop a complete and reasonably compact kit which will include equipment for obtaining and carrying out all necessary testing operations on specimens in the field, and which can be carried and operated by one man with, perhaps, the aid of a laborer. To this end we have built a surface sampler of the Hvorslev fixed-piston type, and are designing and building supplementary equipment which will permit this sampler to be used up to depths of 15 or 20 ft. We have also designed and built an experimental portable testing device with which unconfined compression, triaxial compression, vacuum triaxial compression, and variable lateral pressure compression tests can be performed. This device can also be used for pressure saturation of specimens prior to test and for permeability tests. The device we now have is too complicated for general field use. The idea is to be able to try all testing techniques which may be of value and then to eliminate from the next design for the portable device those features required for tests which do not correlate with field observations. The sampler is now being used for preparation of test specimens to be tested both in the portable device and in existing laboratory equipment; and the effects of the use of the sampler and the portable testing device are being investigated.

Progress of Cooperative Project. Both the Waterways Experiment Station and the Committee have been handicapped in the carrying out of the planned cooperative investigation by lack of personnel. To date the Station has completed the field bearing tests on silty clay in the wet condition and on Vicksburg loess in the dry and wet conditions. The Committee has completed its series of tests on the silty clay in the wet condition, including comparative tests for the evaluation of any errors or differences introduced by the portable sampling and testing equipment, and is now working on the tests on Vicksburg loess. The program has not progressed to the point where definite comparisons can be made between the results of field and laboratory tests. The results to date do indicate that the use of the portable sampling device for the cutting of test specimens, and of the portable testing device, yields results close to those of the most careful laboratory techniques.

Appointment of Research Engineer. After an extensive search, the Committee has been fortunate in securing the services of Dr. J. O. Osterberg, Jun. Am. Soc. C.E., as its Research Engineer beginning October 1, 1943. For two years he was McMullen Research Scholar in Soil Mechanics at Cornell University, where he secured a Ph.D. in Civil Engineering in 1940. He has specialized in soil mechanics research, has had extensive experience with soil pressure cells and electrical strain measuring devices, and has published several papers. His services could only be secured on the basis that he devote about three-quarters of his time to Committee work and the rest to Northwestern University. His appointment should relieve many difficulties arising from lack of trained personnel and should greatly accelerate the progress of the research.

Proposed Continuation of Project. The Committee proposes that its present project be continued during the next fiscal year in order that results may be realized from the work done during the present year and that its obligations in the cooperative project with the Waterways Experiment Station may be fulfilled. Within the next year, it should be possible to complete a recommended field sampling and testing kit with tentative correlated applications for the test results. Final correlations will depend on more extensive use of the equipment in the field at sites where field performance observations have been or will be made. A supplementary investigation which may be worked in with very little additional expense in time and funds is a study of the use of rapid

field tests to determine safe working heights for vertical or steeply sloping cuts in cohesive soils. Failure of an unbraced vertical bank of a trench or pit is a common minor construction accident which, in spite of the small resulting material damage, accounts for a considerable number of construction fatalities. It is probable that several organizations, including the National Safety Council which has called the Chairman's attention to the problems, would agree to cooperate in field tests and observations for this study.

PHILIP C. RUTLEDGE, *Chairman*

Society Officers Nominated for 1944

THE OFFICIAL nominee for President of the Society was chosen by the Nominating Committee on October 11, 1943, in accordance with Article VII, Section 4, of the Constitution. Official nominees for Society offices other than President were determined by the Second Ballot for Official Nominees, canvassed at Society Headquarters on October 15.

The complete list of nominees is as follows:

For President:
Malcolm Pirnie, of New York, N.Y.

For Vice-Presidents:
Zone I, Richard Erwin Dougherty, of New York, N.Y.
Zone IV, Franklin Thomas, of Pasadena, Calif.

For Directors:
District 3, Solomon Cady Hollister, of Ithaca, N.Y.
District 5, Gail Abner Hathaway, of Washington, D.C.
District 7, Raleigh Welch Gamble, of Milwaukee, Wis.
District 8, Wilbur M. Wilson, of Urbana, Ill.
District 9, Frank Clifton Tolles, of Cleveland, Ohio
District 12, William Day Shannon, of Seattle, Wash.
District 16, Royce Jay Tipton, of Denver, Colo.

These nominees will be voted on by final ballot sent to every corporate member at least forty days before the Annual Meeting in New York in January. One week before the meeting the ballots will be canvassed, and the officers thus elected will be inducted into office at the meeting. The official report of the tellers on the Second Ballot follows:

REPORT OF TELLERS ON SECOND BALLOT FOR OFFICIAL NOMINEES

October 15, 1943

To the Secretary
American Society of Civil Engineers

The Tellers appointed to canvass the Second Ballot for Official Nominees report as follows:

For Vice-President, Zone I		
Richard Erwin Dougherty	928	
Void	8	
Total	936	
For Vice-President, Zone IV		
Franklin Thomas	1,081	
Void	15	
Total	1,096	
For Director, District 3		
Solomon Cady Hollister	195	
Void	3	
Total	198	
For Director, District 5		
Gail Abner Hathaway	399	
Void	0	
Total	399	
For Director, District 7		
Raleigh Welch Gamble	255	
Leroy Clarke Smith	166	
Void	1	
Total	422	
For Director, District 8		
Wilbur M. Wilson	238	
Void	0	
Total	238	
For Director, District 9		
Daniel Voiers Terrell	122	
Frank Clifton Tolles	184	
Void	0	
Total	306	
For Director, District 12		
William Day Shannon	179	
Richard Gaines Tyler	87	
Void	0	
Total	266	
For Director, District 16		
Charles Henry Scholer	154	
Royce Jay Tipton	170	
Void	0	
Total	324	
Ballots canvassed		4,185
Ballots withheld from canvass		
From members in arrears of dues	47	
Without signatures	75	
With illegible signature	3	
Total withheld	125	125
Total number of ballots received		4,310

Respectfully submitted,
JAMES McB. WEBSTER, *Chairman*
F. L. GREENFIELD, *Vice-Chairman*

ARTHUR S. PEARSON	LOUIS GOODMAN	ALBERT P. LORIOT
JOSEPH FARHI	SOLOMON B. ARISON	ALFRED M. WYMAN
D. G. BAILLIE, JR.	WILLIAM H. DIECK	HARRY WM. STUBER
EDWIN P. PITMAN	H. NEWMAN	HOWARD HOLBROOK

Tellers

Solicitation by Photo Service Firm Not Authorized by Society

NO PHOTOGRAPHIC studio has been authorized by the Society to solicit the patronage of any member of the Society or any applicant for membership. Recently several complaints have been registered that a commercial studio has offered to take photographs, indicating that "this is at the request of the American Society of Civil Engineers in connection with your application." It is apparent that the names of men approached have been taken from the lists of applications and transfers published in CIVIL ENGINEERING.

At no time has such use of any membership lists by a commercial organization been authorized.

Local Sections Form Committees on Postwar Construction

ACTING promptly in the interests of their own communities, nine Local Sections of the American Society of Civil Engineers have appointed their own committees on postwar construction. Thus they are assuming community leadership in the promotion of interest in plans for the postwar period as expressed in the attitude of the Board of Direction, adopted July 29, 1943 (see page 439 of the September 1943 issue of CIVIL ENGINEERING). This responsibility has been gladly assumed by engineers who recognize that a tremendous job of public education must be done if unemployment and made-work projects are to be avoided at the end of the war.

At the time CIVIL ENGINEERING goes to press the following Sections have formed committees: Northwestern, Mid-South, Los Angeles, Philadelphia, Buffalo, Toledo, Tacoma, Tri-City, and the Dallas Branch of the Texas Section.

Much of the success of the Society's crusade for the preparation of postwar construction programs now will be directly due to the activity of these local groups. Much work will doubtless be necessary before the objectives of the Society are accomplished. However, such work must not fail, for the welfare of the nation as well as that of local communities depends upon the thoroughness with which engineers have prepared to meet the transitional period following the war.

Karl Emil Hilgard Prize Awarded

For the biennium now ending, the Karl Emil Hilgard Prize in Hydraulics is being awarded to Harold A. Thomas, M. Am. Soc. C.E., and Emil P. Schuleen, Assoc. M. Am. Soc. C.E., for their Paper No. 2137, "Cavitation in Outlet Conduits of High Dams," as appearing in Transactions, Volume 107. Confirmation of this award was made by the Board of Direction at its Atlanta Meeting on October 11.

Conditions for the Hilgard Prize differ somewhat from those for the other awards of the Society. For one thing it is given only once in two years, and for another, its administration is under the Society's Hydraulics Division. Consideration is given to the hydraulics papers appearing in each year's Transactions, and then once in two years the recommendation for the award is made.

This award was endowed by, and named in honor of, an eminent Swiss engineer. It commemorates not only his love for America, but the great respect and affection with which he is held in this country.

Delayed Mailing for Transactions

The later-than-normal schedule for issuing the October Proceedings was commented on in the last issue. A similar delay appears imminent for the bound volumes of Transactions, due to similar causes.

It is the old story of wartime limitations, especially as regards materials and labor. There is no question of the will to meet the schedules that have operated for so many years, but it simply does not seem possible to overcome the handicaps of the present year.

In particular, this refers to certain operations of the binding process, starting with the sewing together of the many forms that make up the large 1,700-page volume. This was the bottleneck that handicapped the issuance of Proceedings, Part 1 and Part 2, as previously noted. The same difficulty will be passed along to the so-called hard binding of Transactions in cloth and morocco.

Normally these volumes are put in the mail for about half of our members during November. This year they will probably be delayed for the most part until December. Such delay is regretted even though it is unavoidable. This brief notice in advance will allay any suspicion that errors rather than delays have accounted for the lateness of the bound Transactions.

Society Prize Winners Announced

Winners of Society prizes for the current year have been announced as follows:

Thomas E. Stanton, M. Am. Soc. C.E., the Norman Medal for his paper, "Expansion of Concrete Through Reaction Between Cement and Aggregate."

C. H. Gronquist, Assoc. M. Am. Soc. C.E., the J. James R. Croes Medal for his paper, "Simplified Theory of the Self-Anchored Suspension Bridge."

Paul Baumann, M. Am. Soc. C.E., the Thomas Fitch Rowland Prize for his paper, "Design and Construction of San Gabriel Dam, No. 1."

T. A. Middlebrooks, Assoc. M. Am. Soc. C.E., the James Laurie Prize for his paper, "Fort Peck Slide."

Milton Harris, Assoc. M. Am. Soc. C.E., the Arthur M. Wellington Prize for his paper 2155, "Traffic Engineering as Applied to Rural Highways."

Ray K. Linsley, Jr., and William C. Ackermann, Juniors, Am. Soc. C.E., the Collingwood Prize for Juniors for their paper, "Method of Predicting the Runoff from Rainfall."

George J. Schroepfer, Assoc. M. Am. Soc. C.E., the Rudolph Hering Medal for his paper, "Experiences in Operating a Chemical—Mechanical Sewage Treatment Plant."

These awards were confirmed by the Board of Direction at its Atlanta meeting, October 11, 1943. In all cases, the competition for the present year was confined to papers appearing in the 1942 Transactions, Vol. 107. Ceremonies concerned with the actual bestowing of these prize awards will take place at the 1944 Annual Meeting of the Society in January.

News of Local Sections

Scheduled Meetings

Arizona Section—Fall meeting at the Adams Hotel on November 27, at 9:30 a.m. (all day).

Buffalo Section—Luncheon meeting at the Buffalo Athletic Club on November 19, at 12:15 p.m.

Cleveland Section—Dinner meeting at the Cleveland Engineering Society on November 12, at 6:30 p.m.

Colorado Section—Dinner meeting at the Edelweiss Restaurant on November 8, at 6:30 p.m.

Dayton Section—Luncheon meeting at the Engineers' Club on November 15, at 12:15 p.m.

District of Columbia Section—Smoker at the Cosmos Club on November 23, at 8:15 p.m.

Iowa Section—Afternoon and dinner meeting at the Fort Des Moines Hotel about November 18, at 3 and 6 p.m.

Los Angeles Section—Dinner meeting at the University Club on November 10, at 6:30 p.m.

Metropolitan Section—Technical meeting in the Engineering Societies Building on November 17, at 8 p.m.

Miami Section—Dinner meeting at the Royal Center on November 4, at 7 p.m.

Mid-South Section—Annual meeting at the Claridge Hotel Memphis, Tenn., on November 15, at 9 a.m.

Northeastern Section—Dinner meeting at the Engineers' Club on November 22, at 6 p.m.

Northwestern Section—Meeting on November 1.

Philadelphia Section—Meeting at the Engineers' Club on November 9, at 7:30 p.m.

Sacramento Section—Regular luncheon meetings at the Elks Club every Tuesday at 12 m.

Seattle Section—Meeting at the Engineers' Club on November 29, at 8 p.m.

Tennessee Valley Section—All-day meeting at Knoxville, Tenn., on November 13 at 10 a.m.; dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on November 9, at 5:45 p.m.

Texas Section—Luncheon meeting of the Dallas Branch at the Y.M.C.A. on November 1, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on November 8, at 12:15 p.m.

Recent Activities

Buffalo Section

There was a turnout of 500 for the September meeting of the Section, held jointly with a session of the Engineering Foundation of Buffalo on the evening of the 21st. The principal speaker was Louis F. Sattele, assistant general superintendent of the National Tube Company, who read a paper describing the manufacture of the 1,254 miles of seamless tubing for the "Big Inch" pipeline, most of which was furnished by his company. With the aid of lantern slides, Mr. Sattele showed how the transformation from ore in the steam boat at the dock to finished pipe, in railroad cars, was accomplished in forty-eight hours. Next a sound and color movie, entitled "Oil for War," was presented by the Barrett Division of the Allied Chemical and Dye Corporation. This film showed the field work on the "Big Inch" pipeline from clearing the right of way to throwing the pump switches to operate the line.

Colorado Section

On September 13 Norman Parker addressed a dinner meeting of the Section on the subject of "Postwar Possibilities of the Denver Ordnance Plant." Professor Parker, who is head of the

department of mechanical engineering at the University of Colorado, pointed out that many of the large buildings comprising the plant are of permanent construction and may well be used for any postwar work planned. Likewise, all the general purpose equipment will have many possibilities.

Dayton Section

The winter program began for the Dayton Section on September 20 with a luncheon at the Engineers' Club. F. J. Cellarius spoke to the Section on "Dayton's Traffic Problem and Its Solution." He illustrated his talk with detailed maps, showing how traffic could be routed through the city by making the necessary change in the different routes.

District of Columbia

An address by Maj. Gen. Philip B. Fleming comprised the technical program at the September meeting of the Section. His talk, which was entitled "Must History Always Repeat," concerned the role of public works in the postwar period. There was an attendance of 128 to hear General Fleming who, in his capacity as Federal Works Administrator, has direct responsibility for the Lanham Act war public works and services program.

Kansas City Section

An unusual program—sponsored by Black and Veatch, Kansas City consultants—had been arranged for the September dinner meeting. The nature of the program was explained by N. T. Veatch, Jr., who introduced ten members of his organization who were to have a part in it. The theme of the program was centered in the plan of the American Water Works Association and related organizations to survey the needs of the nation for postwar water and sewage works improvements. Ellsworth Filby, who is to serve as field director of the plan, was in charge of the symposium on postwar improvements that had been prepared.

Los Angeles Section

On September 15 members of the Los Angeles Section held a joint meeting with the Structural Engineers' Association of Southern California. The speaker of the evening was E. L. Durkee, who discussed the erection of the Rainbow Bridge at Niagara Falls, N. Y. Mr. Durkee illustrated the principal elements of the erection procedure by means of diagrams and motion pictures taken in sequence during the progress of the work. He was resident engineer for the Bethlehem Steel Company on the erection of the project.

Providence Section

On Sunday, September 26, the Providence Section in conjunction with the Rhode Island Society of Professional Engineers held an outing and inspection trip. The group of twenty-five men first went out to Cumberland to inspect the Ashton Viaduct, where Daniel O. Cargill, bridge engineer for the Rhode Island State Department of Public Works, described the design and construction problems of the structure, a multiple-span open-spandrel concrete-arch bridge across the Blackstone Valley. Afterwards the group proceeded to nearby Bear Hill Farm, where sports were enjoyed and refreshments served.

Sacramento Section

On September 7 J. L. Bergzen, construction engineer for the Sacramento division of the Pacific Telephone and Telegraph Company, described the laying of an underground cable from Sacramento over the Sierra Nevada and across the Nevada deserts to the Utah line. Colored motion pictures illustrated operation of the tractor train which plowed a trench, placed the cable, and backfilled in a continuous operation even across several rivers. Meetings were held on September 14, 21, and 28 to view semi-technical motion pictures and to hear a discussion of flood-plain zoning from an attorney's viewpoint.

San Diego Section

Experiences encountered on a recent trip to Mexico City constituted the subject of A. I. Benedict's talk before the San Diego Section on September 23. Mr. Benedict is with the San Diego Gas and Electric Company.

St. Louis Section

At a luncheon meeting held on September 27, David C. Spencer spoke on "Japan and Its War Aims." Mr. Spencer, who was born and brought up in Japan, has had contacts there in later years that enabled him to present a very illuminating picture of our foe. Tracing Japanese history from early legends to the present time, he showed their long-range planning for the present struggle and the absolute necessity of obtaining their "unconditional surrender." Mr. Spencer is vice-president of the Globe Ticket Company.

Spokane Section

"Work of great importance will fall to the civil engineers of the country after the war," E. B. Black, Past-President of the Society, told members of the Spokane Section at a luncheon meeting on August 5, when past and present officers of the Society en route home from the Los Angeles Convention were guests of the Section. The same group was entertained at dinner that evening. On the latter occasion George T. Seabury, Secretary of the Society, was the principal speaker.

Tacoma Section

On August 3 members of the Tacoma and Seattle Sections joined in entertaining the group of Society officers touring the Pacific Northwest. After-dinner speakers were Ezra B. Whitman, President of the Society, and Secretary Seabury. Both discussed Society affairs. The September meeting—held at the Lakewood Community Center on the 21st—consisted of a technical session, with C. S. Seabrook as the principal speaker. Mr. Seabrook, who is chief civil engineer in the Area Engineer's Office at Fort Lewis, Wash., discussed the design of sanitary and storm sewers.

Tennessee Valley Section

The Chattanooga Sub-Section met jointly with local groups of the other Founder Societies on September 14. A review of the activities of the Engineers' Council for Professional Development was presented by J. M. Johnson. Then a motion picture, entitled "Precisely So," was shown through the courtesy of General Motors. A talk on "Engineers and Economic Common Sense"—by W. G. Foster, editor of the *Chattanooga News-Free Press*—concluded the program.

On September 14 members of the Knoxville Sub-Section heard Lt. Winston H. Irwin, of the U.S. Naval Reserve, speak on "Engineers and the Naval Reserve."

Texas Section

A talk on the engineer and his relationships comprised the technical program at a meeting of the Dallas Branch held on September 13. This was given by James Z. George, engineer-analyst of Dallas and chairman of the Section's publicity committee.

On the same date members of the Fort Worth Branch heard Hubert Hammond Crane, consulting architect in the Fort Worth regional office of the Federal Works Agency, discuss the relation of architecture and engineering. Mr. Crane also touched briefly on postwar possibilities in the construction field, stating that if the Southwest is to maintain its industrial status, which has been highly developed by the war, it will be necessary to adjust freight rates and otherwise equalize the opportunities heretofore enjoyed by other sections of the country.

Tri-City Section

The Tri-City Section held its first meeting of the fall season in Davenport, Iowa, on October 1. The first part of the session was devoted to the presentation of a technicolor film, entitled "Trees and Homes," which was shown through the courtesy of the Rock Island Lumber Company. Later business matters pertaining to the Section were discussed, and President Flynt spoke on the work of the Section in postwar planning.

Appointments of Society Representatives

Henry T. Heald, M. Am. Soc. C.E., has been appointed to represent the Society on the Committee on Engineering Schools of the Engineers' Council for Professional Development for the term, 1943–1946.

ITEMS OF INTEREST

About Engineers and Engineering

Reabsorb Construction Workers During War, Says Chamber of Commerce

The following statement was adopted by the Construction Industry Committee of the Chamber of Commerce at its meeting in Washington, D.C., on September 15, 1943. The representative of the American Society of Civil Engineers on this committee is Allen J. Saville, M. Am. Soc. C.E.

We, representing a cross section of the construction industry, who have been invited by the WPB to confer on problems related to the war and civilian requirements now facing our country, wish at the outset to make clear our position. We do not advocate, nor will we advocate, any measures that we do not believe compatible with the war effort.

Successful prosecution of the war requires that all our physical facilities—industrial, commercial, housing, railway transportation, highways and streets, food production, water supply and sanitation, and others essential to the public health, welfare, and safety—be maintained in safe and efficient service. This is the minimum need, if maximum war production is to be maintained. Maintenance alone will not hold all of them at an efficient level indefinitely, and some reconstruction and replacement, some expansion and new construction are becoming increasingly necessary.

To attain these ends it seems highly desirable that the WPB and those engaged in lines of endeavor essential to providing these facilities, make a realistic appraisal periodically to determine what portion of our manpower and materials can be allocated to maintaining and improving the facilities cited without interference with the production of material required for the support of our armed forces.

During the period of tuning up for war production, the construction industry satisfactorily fulfilled its obligation and provided plants, housing, and military establishments with a rapidity and efficiency heretofore unexcelled in the world's history. The construction industry is now prepared and should be maintained in a position to perform the obligations which lie ahead.

Few of the nation's basic peacetime industries have experienced more drastic wartime restriction than that which has seemed necessary in the field of private building and construction. The annual volume of new construction for the civilian economy has been reduced from a 1941 level of about eight billion dollars to less than two and one-half billion dollars during the current year. There is a grave question as to whether the current level of civilian construction can be much further reduced without danger of curtailment to a point where indispensable civilian needs will be sacrificed. It may well be that difficulties exist with respect to carrying out essential maintenance and repair work, which might be removed without detriment to the war program and thus facilitate maintenance that cannot be further deferred if our civilian facilities are to be safely and efficiently operated.

If, as, and when war conditions permit, opportunity should be afforded to resume gradually an accelerated rate of civilian construction so that we may regain as much as may be of the loss which has been sustained due to the substandard maintenance of such facilities which has prevailed during the last two years, and provide the replacements and new facilities, the need for which is becoming increasingly apparent.

Therefore it seems highly desirable now that we start to plan this program of orderly reconversion from maximum war production on a step-by-step basis, to the end that as war workers and service men are released they may be absorbed in our economy and their talents devoted to useful enterprise.

Only the war agencies, the WPB, and the WMC have access to the confidential information and statistical facilities that are needed to tell us which materials and what segments of the nation's manpower will become available first. When those facts are known, the construction industry can proceed intelligently with its preparation to meet the critical problems that must be faced from now until the end of the war, and the even more critical problems that must be faced at the close of hostilities.

N. G. Neare's Column

Conducted by

R. Robinson Rowe, M. Am. Soc. C.E.

"Remembering the excursion of the Engineers Club on October 16, 1940, to see the speed trials of the Dunking Bridge at Nonesuch Narrows, you will be interested to hear a surprising sequel from Hybrid Engineer Ken Bridgewater."

"It won't surprise them all, Noah—just those skeptics who witnessed the successful trials and scoffed, 'There isn't any such bridge!' My able friend, Brigadier Hull of the Royal Engineers, just built another in the Middle East. It works! Hull solved three problems that didn't exist at Nonesuch Narrows—a strong current, combined highway and railway traffic, and lack of machinery. His Dunking Bridge is operated by hand hoists. It's a honey."

"Thanks, Ken. Hope we get more details after the war. Now for the Club's home work, to find the volume common to two cylinders of 3-ft and 2-ft radii if their axes intersect at an angle of 30°."

"I didn't get far," said Joe Kerr. "If a and b are the respective radii and ϕ the angle between axes, the volume

$$V = 8 \csc \phi \int_0^b \sqrt{(a^2 - x^2)(b^2 - x^2)}\, dx$$

which leaves you in the predicament of Fearless Fosdick when he was kidnapped by Stoneface. I came tonite to see you escape."

"It's an old gag," buzzed Amos Keaton. "Byerly published it with $\phi = 90°$ in his *Integral Calculus* in 1881. From his answer:

$$V = \frac{8a}{3} \csc \phi \left[(a^2 + b^2) E\left(\frac{b}{a}, \frac{\pi}{2}\right) - (a^2 + 2b^2) K \left(\operatorname{mod} \frac{b}{a}\right) \right]$$

$$= 16(13E - 17K)\left(\operatorname{mod} \frac{2}{3}\right) = -203.6 \text{ ft}^3$$

"I suppose the minus sign means that the volume of a hole is the volume of something not there anymore!"

"No," interposed Cal Klater. "Every master is entitled to one mistake. In this case the coefficient of K should have been $-(a^2 - b^2)$, so that

$$V = 16(13E - 5K) = +141.872219444 \text{ ft}^3."$$

"Good eye," agreed the Professor.

"I might add," continued Cal, "that the problem can be solved without elliptic functions. Dividing b into 20 equal parts and applying Simpson's Rule, I found $V = 142.2$. That's close enuf for pay quantities. Or expanding $(a^2 - x^2)^{1/2}$ binomially,

$$V = 8a \csc \phi \int_0^b \left(1 - \frac{x^2}{2a} - \frac{x^4}{8a^4} - \frac{x^6}{16a^6}\right) \sqrt{b^2 - x^2}\, dx$$

which can be integrated term by term to get

$$V = 2\pi a b^2 \csc \phi \left(1 - \frac{b^2}{8a^2} - \frac{b^4}{64a^4} - \frac{5b^6}{1{,}024a^6} \cdots\right)$$

$$= 2\pi a b^2 \csc \phi \left[1 - \sum_{n=1}^{\infty} \left(\frac{1 \cdot 3 \cdot 5 \ldots (2n-1)}{2 \cdot 4 \cdot 6 \ldots 2n}\right)^2 \frac{b^{2n}}{(n+1)\,(2n-1)a^{2n}}\right]."$$

"Splendid, Cal, or should I call you Professor Klater? Less workable, but more concisely, the series can be put:

$$V = 2\pi a b^2 \csc \phi \sum_{n=0}^{\infty} \frac{(2n!)^2}{(n+1)(1-2n)\,(n!)^4} \left(\frac{b}{4a}\right)^{2n}."$$

"I'd like to add one more reference, Professor, to Sack's general solution

(*Engineering News-Record*, Vol. 128, p. 618). Use of his tables deprives the problem of its glamour, but gets the answer in a hurry."

"So it does. And since Sack didn't cover the case of the groove, he won't help our estimator in his present dilemma. A last-minute change in the field shifted the axis of the sewer 3 ft until it was just tangent to the cylindrical pier. What was the final deductable volume?"

[*Cal Klater is, synthetically, Richard Jenney, Claude W. West, James R. Bole, Barney (Francis S. Harvey), and Allen H. Brownfield. Brigadier Hull's Dunking Bridge is vouched for by Waldo G. Bowman ("Engineering News-Record", Vol. 131, p. 500).*]

"Gleanings from Hydrology" on File

What would it be worth to have access to a century or more of discharge records along the Mississippi River system? Obviously, millions of dollars. Otherwise, current programs of stream gaging could not be justified or financed. Students of hydrology who understand the importance of having such records available owe a debt of gratitude to C. S. Jarvis, M. Am. Soc. C.E., for making available, entirely at his own expense, a 90-page photo-offset pamphlet entitled *Supplementary Gleanings from the Field of Hydrology*. This work should be of interest to readers of Society publications inasmuch as it supplements many of Dr. Jarvis' outstanding contributions in this field published in Transactions over a period of twenty-nine years.

The *Gleanings* include: Hydrographs of the Delaware River system beginning in 1884 and of the Mississippi River beginning in 1871; several thousand tabulated items of discharge records for the Mississippi and Ohio River systems; rainfall and runoff records for Arizona and New Mexico; schematic drawings and "tree" graphs showing physical data for the Mississippi, Ohio, Muskingum, Kansas, Red, Trinity River systems, and a bibliography of 67 references.

Dr. Jarvis has filed complimentary copies of *Gleanings* at the libraries of 112 educational institutions throughout the United States as well as Cambridge University in England the Universities of Alaska, Hawaii and Puerto Rico, and the College of Agriculture and Mechanics at Mayaguez, Puerto Rico.

The official libraries of 32 of the 48 states, and the following free public libraries: Fresno, Calif.; Louisville, Ky.; Detroit, Mich.; Las Vegas, Nev.; Pittsburgh, Pa.; Tacoma, Wash.; Milwaukee, Wis.; Fort Worth, Tex.; Provo, Utah; Norfolk, Va.; Spokane, Wash.; Dallas, Tex.; Ogden, Utah; San Antonio, Tex.; Salt Lake City and Cedar City, Utah—forty-nine in all, have copies of the *Gleanings* on file.

The libraries of four federal agencies in Washington, D.C.—the Department of the Interior, the War Department, the Department of Agriculture, and the Weather Bureau—received complimentary copies, as did two special libraries at opposite ends of the country—the Mechanics Institute Library at San Francisco and the Engineering Societies Library in New York. It is thus hoped that this collection of rare data, representing so much effort by a single individual, in a worthy project, will be found accessible to all those who may have use for it.

Supplementary Gleanings from the Field of Hydrology undertakes to show, step by step, how the early fragmentary records were either extended or supplemented in order to bridge the gaps, and then to compare the results of various tests intended to display both the consistencies and the disagreements. Taken in connection with the antecedent papers listed under bibliographic references, this pamphlet presents most of the basic data and illustrates the methods devised or adopted for their interpretation and utilization.

Extra copies of the pamphlet may be obtained from Brentano's Book Stores, Washington, D.C., at 60 cents a copy.

Highway Research Board to Meet in Chicago

Announcement has been made that the 23rd annual meeting of the Highway Research Board will be held November 27–30 at the Edgewater Beach Hotel in Chicago.

The first two days, November 27 and 28, will be devoted to meetings of the various committees and departments. Technical sessions, consisting of the presentation of papers on highway finance, economics, design, materials, construction, maintenance, traffic, and soils investigations, will be held the last two days.

Seabees Seek Construction Officers

The Construction Battalions of the Navy are in immediate need of officers experienced in field construction work. The broader the experience the better—highways, water supply, structures of all types. Men with adequate qualifications will be commissioned and assigned to duties with the Construction Battalions outside the United States. The work will consist primarily of constructing advance bases.

Qualifications emphasized are experience in directing construction work of every kind and ingenuity in using all sorts of equipment and material and men. A rugged physique is especially important, for applicants must meet Navy physical requirements. Candidates must be from 21 to 50 years of age. Those under 35 will be required to have a technical degree from an engineering school of recognized standing. For those over 35 years of age, 10 to 15 years of experience will be accepted as sufficient qualification. This experience must be substantiated by evidence of responsible positions held and sound professional standing.

Commissions granted, with annual base pay, are Lieutenant Commander, $3,000; Lieutenant, $2,400; Lieutenant (jg) $2,000; Ensign, $1,800. Allowances for rent and subsistence increase these basic amounts substantially. For duty at sea or outside the continental United States, commissioned officers receive an additional 10% of their base pay.

Inquiries should be addressed to the nearest Office of Naval Officer Procurement. These offices are located in the principal cities of the United States.

NEWS OF ENGINEERS

Personal Items About Society Members

Daniel A. Helmich, for a number of years highway engineer for Jefferson County, Alabama, has been commissioned a lieutenant in the Construction Battalions of the U.S. Navy. At present he is serving as instructor at Camp Peary, Virginia.

Herbert J. Morrison was recently promoted from the rank of second lieutenant in the U.S. Army to that of first lieutenant. Prior to receiving his commission, he was estimating engineer for the Miami (Fla.) Department of Water and Sewers.

Murray Falkin, George Fox, and Sherman Glass have severed their engineering connections with Frederic R. Harris, Inc., of New York, in order to report for active duty with the U.S. Navy. All have the rank of ensign.

Kenneth K. King, director of the Kansas City (Mo.) Water Department, has been appointed Public Works Director, succeeding the late Arthur C. Everham. The position of director of the Water Department will be filled by Melvin P Hatcher, formerly chief engineer and superintendent of the department.

William W. Aultman, lieutenant, Civil Engineer Corps, U.S. Naval Reserve, was recently made an executive officer of the naval post at Dutch Harbor in the Alaskan theater of operations. Before being called to active duty, Lieutenant Aultman was sanitary engineer for the Metropolitan Water District of Southern California.

Charles G. Prahl has been promoted from the rank of lieutenant in the Civil Engineer Corps of the U.S. Naval Reserve to that of lieutenant commander. At present he is naval officer in charge of construction at the Marine Air Base at Edenton, N.C.

Ulric R. Grey is now city engineer of Albany, Calif. He succeeds Harry I. Dygert, who resigned. Mr. Grey was formerly office engineer for the building department of the City of Berkeley, Calif.

Ross E. Wilson, until recently chief engineer for the Firestone Plantations Company in Liberia, West Africa, has been named general manager of the development. Mr. Wilson has been with the Firestone Plantations Company since 1925.

Ralph A. Tudor, lieutenant colonel, corps of Engineers, U.S. Army, has been appointed district engineer for the U.S. Engineer Department at Portland, Ore.

Arthur Jay Benline, on leave from his position as superintendent of the New York City Department of Housing and Building, was recently promoted to the rank of commander in the Civil Engineer Corps of the U.S. Naval Reserve. Commander Benline is now overseas.

Otis Wadsworth Hovey has joined the staff of Alloys Development Corporation, with offices in New York and Pittsburgh, Pa. Mr. Hovey, who has spent the past several years on design problems in connection with freight-train equipment, will serve in the capacity of development and design engineer.

Harold Douglas Rouse, formerly assistant engineer for the Walsh-Driscoll Company at Port of Spain, Trinidad, has accepted a position with Pan-American Airlines—Airport Development Program Division. He is general superintendent on one of the organization's large projects.

Lewis A. Young, who is with the engineering section of the Division of Health and Sanitation of the Office of the Coordinator of Inter-American Affairs, has been promoted from the rank of captain in the Sanitary Corps of the U.S. Army to that of major.

Frank W. Edwards has resigned as chief of the engineering division of the U.S. Engineer Office at Wilmington, N.C., in order to accept a position on the faculty of Pennsylvania State College. Professor Edwards was formerly chief of hydraulic design and research for the Third Locks Project, the Panama Canal.

William A. Alexander, until lately assistant civil engineer for the U.S. Engineer Department at San Bernardino, Calif., has been commissioned an ensign in the 9th Special Construction Battalion and is now in the South Pacific.

Robert S. Calland has been appointed assistant regional director of the U.S. Bureau of Reclamation and has been called to Washington for conference on the new regional organization. He was formerly district engineer for the Bureau at Sacramento.

Edward Gustaf on is now a first lieutenant in the Coast Artillery Corps and is at present stationed at Fort Monroe, Va., where he is taking a refresher course for officers.

Paul L. Nichols was recently promoted from the rank of captain in the Corps of Engineers, U.S. Army, to that of major. He has been transferred from Fort Leonard Wood, Missouri, to Camp Abbott, Oregon, where he is chie of the pioneer training branch of the Engineer Replacement Training Center.

William W. Stecker, first lieutenant in the Coast Artillery Corps of the U.S. Army, has been reported a prisoner of the Japanese. Lieutenant Stecker was stationed at Fort Mills in the Philippines.

Harold F. Hammond, director of the traffic division of the National Conservation Bureau, was elected president of the Institute of Traffic Engineers at the two-day national conference held in Chicago on October 3 and 4.

Maj. Myron W. Tatlock has been given a military leave of absence to report to the Provost Marshal General's School at Fort Custer, Mich., for civil affairs training in military government. Major Tatlock has for some time been in the service of the City of Dayton as superintendent of sewerage operations.

Garner W. Miller, lieutenant colonel, Corps of Engineers, U.S. Army, recently assumed the duties of district engineer for the Memphis Engineer District, relieving **Col. Jarvis J. Bain**, who is to be retired. Colonel Miller was formerly chief of operations for the District.

Marcel Garsaud, who has been serving as a colonel in the Corps of Engineers, U.S. Army, at Philadelphia, Pa., has resumed his consulting practice, with offices in the American Bank Building, New Orleans, La. He will specialize in terminal operation, industrial development, and organization and management.

Herbert J. Wild, colonel, Corps of Engineers, U.S. Army, has retired as executive officer for the Seattle Engineer District to return to civilian life. In 1939 Colonel Wild retired as U.S. district engineer at Seattle, but was recalled to active duty in April 1941 as a result of the war emergency.

DECEASED

Nelson John Bell (M. '24) consulting engineer of Dayton, Ohio, died on June 29, 1943, at the age of 61. From 1906 to 1911 Mr. Bell was assistant city engineer of Dayton, and from 1911 to 1931 chief engineer for Schenck and Williams, Dayton architects. Since 1932 he had maintained his own consulting practice in Dayton.

George Glover Blackmore (M. '30) of Jackson Heights, N.Y., died recently at the age of 68. From 1902 to 1912 Mr. Blackmore was engineer and superintendent for the Wilson and Baillie Company, Brooklyn contractors, on the construction of Brooklyn subways, and later was engaged on similar work in New York City for the Rapid Transit Subway Construction Company. From 1927 until his retirement a year ago he was chief engineer for the George J. Atwell Foundation Corporation, of New York City, on heavy foundation work for tall-building construction.

Paul Alexander Blackwell (M. '20) of Roanoke, Va., died at his home there recently. Mr. Blackwell, who was 64, was with the Virginia Bridge Company from 1907 until 1940, when ill health forced him to retire. He was assistant engineer from 1907 to 1922, and chief engineer from the latter year on. Earlier in his career he had been with the Fort Pitt Bridge Works, of Pittsburgh, and designer for Charles G. Schade.

Orrin Lawrence Brodie (M. '13) designing engineer for the New York City Board of Water Supply, died at his home in Westerleigh, Staten Island, on October 5, 1943. He was 64. Mr. Brodie first became connected with the Board of Water Supply in 1906, being in charge of the design squad on Ashokan, Kensico, and Silver Lake dams and reservoirs. During the first World War he worked on nitrate projects at Muscle Shoals, Ala. From 1919 to 1927 he was assistant design engineer on the construction of the Holland Tunnel. In the latter year he resumed his connection with the Board of Water Supply and was placed in charge of studies and designs for City Tunnel No. 2 and the Delaware Aqueduct.

Knox Folsom Burnett (Assoc. M.'34) of Fort Meyers Beach, Fla., died on August 13, 1943, at the age of 40. Prior to becoming ill about a year ago, Mr. Burnett was project engineer for the Caribbean Architect-Engineer—first at Port of Spain, Trinidad, and later at Antigua, B.W.I. Earlier in his career (1925 to 1932) he was structural designer for Davis and Wilson, Lincoln (Nebr.) architects. More recently he had been with the Platte Valley (Nebraska) Public Power and Irrigation Project in a similar capacity, and for three years he was exhibit engineer at the New York World's Fair.

Benjamin O'Connor Childs (M. '35) district engineer for the Soil Conservation Service, U.S. Department of Agriculture, Montpelier, Vt., died on May 13, 1943. He was 57. From 1910 to 1917 and, again, from 1924 to 1929, Mr. Childs was in private practice—after 1924 as president of the Childs-Hill-Jones Company in Georgia and Florida. Except for three years in private practice, he was with the U.S. Department of Agriculture from 1929 on—stationed in the South for most of this period. During the World War Mr. Childs served in the Ordnance Department of the U.S. Army, having the rank of major.

Max Harry Doyne (M. '28) Director of Public Utilities for the City of St. Louis, Mo., was one of the victims of the glider crash in St. Louis on August 1, 1943. His age was 52. From 1916 to 1941 Mr. Doyne was chief engineer and general manager of C. E. Smith and Company, St. Louis consultants. During part of this period he also acted as consulting engineer to the Louisiana Public Service Commission and the Canadian Pacific Railway. In 1941 Mr. Doyne became director of public utilities.

John Thompson Eastwood (M. '04) consulting engineer of New Orleans, La., died on January 2, 1943, though the Society has just heard of his death. He was 74. From 1903 to 1932 Mr. Eastwood was principal assistant engineer for the Sewerage and Water Board of New Orleans. Before that he had acted as assistant engineer on the design and construction of a water works and sewerage system for New Orleans, and at various times had been in private practice in Portsmouth, Va.

Frank Harvey Eno (M. '03) emeritus research professor in engineering at Ohio State University, Columbus, Ohio, died suddenly on August 7, 1943. Professor

Eno, who was 78 joined the faculty of Ohio State University in 1902 and remained there for the rest of his career, retiring from active service in 1935. An authority on road building and pioneer in the testing of road construction, Professor Eno was instrumental in establishing the Engineering Experiment Station for highway research activity at the University. He had served as chairman of the Highway Research Board of the National Research Council, as governor of the Ohio Good Roads Federation, and as member of various international road congresses.

Charles Maynard Farrow (Assoc. M. '24) captain, Corps of Engineers, U.S. Army, Montgomery, Ala., died there on September 16, 1943. Captain Farrow, who was 46, was placed on the inactive list a few weeks before his death. Except for a period overseas with the A.E.F. in the first World War and his services in the present war, Captain Farrow had been in the engineering employ of Montgomery County for most of his career—as assistant county engineer from 1919 until he received his commission about a year ago.

George Addison Field (Assoc. M. '30) construction engineer of Houston, Tex., died there on September 3, 1943, at the age of 42. Mr. Field was connected with Brown and Root, Inc., as project manager on the construction of shipyard facilities for the Houston Shipbuilding Corporation. He had also superintended the construction of Army and Navy facilities in other parts of the state. For a number of years he was a member of the contracting firm, Field Brothers and McCelvey, at Lubbock, Tex.

Eric Hjalmar Frisell (Assoc. M. '07) of Oakland, Calif., died on August 23, 1943, at the age of 69. Born and educated in Sweden, Mr. Frisell came to New York in 1895. His first work was as draftsman on the first bridge to be built over the Niagara River. Later (1905 to 1913) he was chief engineer for Milliken Brothers, of New York, on projects in Norway, Mexico, and California. For the next seventeen years he was president of the California Steel Company with headquarters in San Francisco. Mr. Frisell organized the California chapter of the American-Scandinavian Foundation and served as its president for fifteen years.

Herbert Thurston Gerrish (M. '28) president of the Trimount Dredging Corporation of Boston, Mass., died on September 6, 1943. Mr. Gerrish, who was 57, was treasurer and general manager of the Trimount Dredging Corporation from 1923 to 1930, and president from the latter year on. Earlier in his career he had been with the Eastern Dredging Company and the Gerrish Dredging Company. During the first World War he served with the 218th Engineers, attaining the rank of captain.

William Albert Hansell (M. '14) assistant chief of construction and engineer of sewers for the city of Atlanta, Ga., died on September 9, 1943. Mr. Hansell, who was 70, had been identified with Atlanta public works most of his life and was one of the leaders in developing the city's metropolitan sewerage system. He had served as chief of construction of the city and as superintendent of public works of Fulton County, and at one time was a member of the consulting firm, Hansell and Enloe.

Thomas Jefferson Harris, Jr. (Jun. '42) aircraft stress analyst for the Curtiss-Wright Corporation at Columbus, Ohio, died in that city on August 8, 1943. He was 23. Mr. Harris graduated from Pennsylvania State College in 1942, receiving the degree of B.S. in C.E.

William Garrigues Hartranft (Affiliate '98) chairman of the Phoenix (Ariz.) City Planning and Zoning Commission, died during the past summer. Before going to Arizona in 1929, Mr. Hartranft was for many years in active business in Philadelphia, being president of the William G. Hartranft Cement Company.

Louis Armstead Heindl, Jr. (Jun. '42) lieutenant, Infantry, U.S. Army, was killed in an aircraft accident at the Orlando (Fla.) Air Base on September 19, 1943. Lieutenant Heindl, who was 23, received the degree of B.S. in C.E. from Virginia Military Institute in 1942.

Ernest George Matheson (M. '13) of Vancouver, B.C., Canada, died in December 1942, though the Society has just heard of his death. He was 77. Born and educated in Canada, Mr. Matheson spent part of his career in this country, having been with the New York City Rapid Transit Company, the Foundation Company, and the O'Rourke Engineering Construction Company. Later he returned to Canada, where he served for a number of years as professor of civil engineering at the University of British Columbia.

Charles William McMeekin (M. '14) consulting engineer of Berkeley, Calif., died two years ago, though word of his death has just reached the Society. Mr. McMeekin, who had for many years maintained a consulting practice in California, served on the General Staff in Washington during the first World War, having the rank of lieutenant colonel.

Augustus Franklin Reese, Jr. (Jun. '40) of Shallowater, Tex., was killed in action overseas on May 14, 1943. His age was 25. He had the rank of first lieutenant in the Air Corps and was a member of the 94th Fighter Squadron—1st Fighter Group. A graduate of Texas Technological College in 1939, Lieutenant Reese was an engineer for the Texas State Highway Department before enlisting in the Air Corps.

Orville Adniroum Smith (Assoc. M. '28) designer of sanitary sewers for the City of Los Angeles, died at his home at San Marino, Calif., on September 5, 1943. Mr. Smith, who was 64, had been in the office of the city engineer of Los Angeles for the past eighteen years. Prior to that he was with the Kansas City (Mo.) firm of Black and Veatch. A veteran of the first World War, Mr. Smith held the rank of major in the reserve corps.

Charles Sleeper Sterling (M. '27) engineer for Finch and Sargent, of Albany, N.Y., died on September 6, 1943, at the age of 64. Mr. Sterling was with the New York State Department of Public Works from 1915 to 1924. He then became associated with Frank M. Williams, Albany consultant, on hydraulic and hydroelectric investigations and reports, and for the past several years had been with Finch and Sargent. At one time, he maintained his own consulting practice.

William Jonathan Weisshaupt (Jun. '39) construction engineer for the Morrison-Knudsen Company, Inc., at Tooele, Utah, died in Salt Lake City, Utah, on May 11, 1943, as the result of injuries received in an elevator accident. He was 28. Mr. Weisshaupt had been with the Morrison-Knudsen Company in varying capacities for several years, serving as job superintendent for them on projects in different parts of the country.

Daniel Merrick Wheeler (M. '01) died at his home in Pittsfield, Mass., on September 29, 1943. Mr. Wheeler was one of the last surviving members of the first class at Massachusetts Institute of Technology, from which he graduated in 1868. Much of his career was devoted to railroad building—first in Massachusetts and, then, as chief engineer of a railroad in South America. In 1894 he was appointed Massachusetts State Inspector of Railroads, from which position he was retired in 1916, having reached the legal age limit of 70 years. Mr. Wheeler thereupon became chief engineer of the Berkshire Electric Railway system, working steadily in that position until a few weeks before his death at the age of 97. He was actively engaged in his profession for 75 years.

Harry James Wight (M. '38) of Knoxville, Tenn., died on July 30, 1943, at the age of 62. Mr. Wight spent his early career in railroad work. He then (1923) entered the Knoxville city engineering department, and in 1927 was made city engineer. He became director of public service for the city in 1933 and served in that capacity until 1938. From the latter year to 1941 he was with the Knoxville Housing Project. After a brief period with the Tennessee Valley Authority, he returned to the city engineering department where he remained until his death.

Le Roy Zimmerman Wilson (M. '30) who was with Hume Steel Ltd., in Sydney, Australia, died there recently. A native of Canada, Mr. Wilson was with the Dominion Bridge Company for a number of years—finally as vice-president. He built the Montreal Harbor Bridge, and in 1935 was invited to Australia to construct the Brisbane Harbor Bridge. Since the completion of the bridge he had made his home in Australia. During the first World War he enlisted with the Canadian Overseas Railway Construction Corps and was awarded the Military Cross.

Albert Wolstenholme (M. '06) civil engineer of Fall River, Mass., died in April 1943, though word of his death has just reached the Society. Most of Mr. Wolstenholme's career was spent in Fall River, where for a number of years he served as city engineer.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From September 10 to October 9, 1943, Inclusive

Additions to Membership

Adams, Harrold Nelson (Jun. '43), 76 Windham Rd., Willimantic, Conn.

Anderson, Van Keith (Jun. '43), Junior Draftsman, Humble Oil & Refining Co. (Res., 267½ New Jersey), Baytown, Tex.

Ballard, Richard Patton (Jun. '43), 1177 Amherst Ave., West Los Angeles 24, Calif.

Ballenger, Robert Daniel (Assoc. M. '43), Asst. Engr., Office, Div. Engr., South Atlantic Div., U.S. Army, 50 Whitehall St. (Res., 936 Rosedale Rd., N.E.), Atlanta, Ga.

Bartlett, Frank Adams (Assoc. M. '43), Asst. Engr., S. P. Ry., Union Station (Res., 2435 North East 60th Ave.), Portland, Ore.

Bateman, John Henry (Jun. '43), Design Engr., The Marley Co., Inc., 3001 Fairfax Rd. (Res., 1213 North 18th St.), Kansas City, Kans.

Beadie, William McGregor (Assoc. M. '43), Asst. Commr., Aeronautics, State Dept. of Aeronautics, State Capitol (Res., 1714 Portland Ave.), St. Paul, Minn.

Beaulieu, Arthur George (M. '43), Chf. Structural and Civ. Engr., Westcott & Mapes, Inc., 139 Orange St., New Haven (Res., 55 Fernwood Rd., Hamden), Conn.

Benert, Robert (Jun. '43), 2d Lt., Air Corps, U.S. Army, Army Electronics Training Center, Austin Hall, Harvard Univ., Cambridge, Mass.

Birnbaum, Arthur (Jun. '43), Private, U.S. Army, Company B, 4th Battalion, 2d Platoon, Engr. Replacement Training Center, Fort Belvoir, Va.

Boeck, Ralph Elmer (M. '43), Civ. Engr., Worden Allen Co., Box 2057 (Res., 3889 North 4th St.), Milwaukee 12, Wis.

Booth, Weldon Sutherland (Jun. '43), Asst. Engr., Stone & Webster Eng. Corp., Clinton (Res., 412 Garden Ave., Fountain City), Tenn.

Brandes, Joseph Leon (Jun. '43), Draftsman, Carnegie-Illinois Steel Co. (Res., Y.M.C.A.), Youngstown 3, Ohio.

Breen, Meyer (Assoc. M. '43), Associate Engr., U.S. Engr. Office, San Juan, Puerto Rico.

Brewer, Mathias, Jr. (Assoc. M. '43), Associate Engr., Parsons, Brinckerhoff, Hogan & Macdonald, Apartado 168, Caracas, Venezuela.

Brodsky, Andrew (Jun. '43), Tutor, Civ. Eng., School of Technology, College of the City of New York, Amsterdam Ave. and 139th St. (Res., 526 West 113th St.), New York 25, N.Y.

Brown, Hoyt Cuthbert (Assoc. M. '43), Div. Engr., State Highway Dept., Box 1117 (Res., 133 Hines Terrace), Macon, Ga.

Browne, Walter Estaugh (M. '43), Cons. Engr., 720 North Jefferson St., Milwaukee, Wis.

Brubaker, John Henry, Jr. (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, EORP, Group 1, Engr. Replacement Training Center, Fort Belvoir, Va.

Burrell, Harold Portal (M. '43), Chf. Engr., Western Foundation Co., 52 Vanderbilt Ave. New York, N.Y. (Res., 25 Sedgwich Ave., Darien, Conn.)

Butterwick, Ward Richard (Assoc. M. '43), Civ. Engr., 1370 Peabody, Washington, D.C.

Campbell, George Frederic (Jun. '43), Corporal, Coast Artillery Corps, U.S. Army, 652 South Grove, Wichita, Kans.

Cappellari, Amerigo Severino (Jun. '43), With U.S. Army, 716 South Kanawha St., Beckley, W.Va.

Carlson, Quinton Lambert Reinhart (Jun. '43), Ensign, U.S.N.R., 48 Seaver St., North Easton, Mass.

Carnine, James Harrison (M. '43), Pres., Eng. Metal Products Corp., 401 South Harding St. (Res., 331 West 44th St.), Indianapolis, Ind.

Cartier, Leonard (Jun. '43), Asst. Prof., Ecole Polytechnique, 1430 St. Denis St., Montreal, Que., Canada.

Chastain, Theron Zolly (Jun. '43), Naval Archt., P-1, Navy Yard (Res., 6 A Victory Court Apartments), Charleston 26, S.C.

Cliggett, James John (Assoc. M. '43), Civ. Engr. (Structural), Head, Structural Design Section, U.S. Engr. Office, 575 Riverside Ave. (Res., 1517 Parrish Pl.), Jacksonville 5, Fla.

Cochrane, Joseph Derr (Assoc. M. '43), With P.R.R., 310 Union Station, Erie, Pa.

Cooper, Hilton Hammond, Jr. (Assoc. M. '43), Asst. Engr. U.S. Geological Survey, Box 631, Tallahassee, Fla.

Cooper, Samuel Clarence (Assoc. M. '43), City Engr., City Hall, Big Spring, Tex.

Cox, Hayward Carlton (Assoc. M. '43), Senior Engr. (Civ.), Corps of Engrs., War Dept., 50 Whitehall St. (Res., 35 Peachtree Hills Ave.), Atlanta, Ga.

Cronkhite, Forrest Ivan (Assoc. M. '43), Senior Engr., Corps of Engrs., U.S. Army, 907 Calvert Bldg., Baltimore 2, Md.

Daniels, Orval William (Jun. '43), 3904 Calmont, Fort Worth 7, Tex.

Davies, Lester Henry (Jun. '43), Aviation Cadet, Air Force, U.S. Army, Squadron B, Div. 6, AAFTTC, Yale Univ., New Haven, Conn.

Dawson, James Weaver (M. '43), Asst. Engr., Floyd, Chappell & Gieb, Texas Bank Bldg., Dallas, Tex. (Res., 2105 Hickory St., Texarkana, Ark.)

Di Martino, Dominic Donald (Jun. '43), 86 Clare Ave., Hyde Park 36, Mass.

Doepke, Henry August (Jun. '43), 2501 Fifth Ave., South, Minneapolis 4, Minn.

Doerres, John Herman, Jr. (Jun. '43), Junior Draftsman, Humble Oil & Refining Co., Humble Dormitory, Baytown, Tex.

Drago, Emanuel Anthony (Assoc. M. '43), Associate Engr., U.S. Engr. Office, Mobile, Ala.

Earl, Lawrence William (Jun. '43), Corporal, Corps of Engrs., U.S. Army, Box 39, Stillwater, N.J.

Emberton, Raymond Basil (Jun. '43), Lt., Corps of Engrs., U.S. Army, Shaw Field, Sumter, S.C.

Essi, Vernon Ferris (Assoc. M. '43), Lt. (jg), U.S.N., 2822 Thirty-first St., S.E., Washington 20, D.C.

Fagre, Roland Arthur (Jun. '43), Ensign, CEC-V (S), U.S.N.R., Estherville, Iowa.

Fanning, John Glen (Jun. '43), Asst. Civ. Engr., Civ. Aeronautics Administration, Anchorage, Alaska.

Felder, Charles Edwin (Jun. '43), Ensign, EV (S), U.S.N., 1123 Leontine St., New Orleans, La.

Fisher, Robert Joseph (Jun. '43), Carpenters Mate, 2d Class, U.S.N., 125 Lafayette Ave., Oreland, Pa.

Forsyth, Benjamin (Assoc. M. '43), Structural Designer, F. R. Harris, 27 William St. New York (Res., 1026 President St., Brooklyn 25), N.Y.

Freeman, Carlyle Bancroft (M. '43), Pres., Freeman & Jones, Inc., 6007 Euclid Ave., Cleveland (Res., 3160 Chadbourne Rd., Shaker Heights), Ohio.

Fromherz, Frank Charles (Jun. '43), Junior Stress Analyst, Goodyear Aircraft Corp., 1210 Massillon Rd., Akron, Ohio. (Res., 1430 Clay Ave., New Orleans, La.)

TOTAL MEMBERSHIP AS OF OCTOBER 9, 1943	
Members	5,991
Associate Members	7,275
Corporate Members	13,266
Honorary Members	32
Juniors	5,719
Affiliates	72
Fellows	1
Total	19,090
(Total October 9, 1942	17,951)

Frost, Henry Lewis (Jun. '43), Industrial Engr., Goodyear Aircraft Corp., 1210 Massillon Rd. (Res., 161 South Balch St.), Akron 3, Ohio.

Gabbe, Henry Walter (Assoc. M. '43), With U.S.N., 700 Ocean Ave., Brooklyn 26, N.Y.

Garris, Charles Augustus (Assoc. M. '43), 1417 Carswell St., Baltimore, Md.

Garnett, James Clifford (Assoc. M. '43), Lt. Col., Royal Engrs., British Army Staff, Engr. Liason Officer to U.S. Engr. Board, Fort Belvoir, Va.

Gayton, John Edward (Jun. '43), Ensign, U.S.N.R., 486 Michigan Union, Ann Arbor, Mich.

Gilbert, Jack Hite (M. '43), Comdr., CEC, U.S.N.R., Officer in Chg., Constr., Box 230, Norman, Okla.

Glaze, Vernon Louis (M. '43), Prin. Engr., U.S. Engr. Dept., 207 Post Office Bldg. (Res., 1402 Fifty-first St.), Sacramento, Calif.

Groth, Harold Wesley (Assoc. M. '43), Chf. Engr., Cleveland Met. Park Dist., 1328 Standard Bldg., Cleveland, Ohio.

Halper, Harold Herbert (Jun. '43), With U.S.N., 474 East 55th St., Brooklyn 3, N.Y.

Hansen, Richard Cecil (Jun. '43), Chf. Engr., Naval Airways Pilot and/or Airway Manual, Univ. Bldg., 910 Sixteenth St. (Res., 1[illegible] Lafayette), Denver 6, Colo.

Hardes, John Franklin (Assoc. M. '43), Engr., Highway Planning, State Highway Comm., Masonic Temple (Res., 1730 High St.), Topeka, Kans.

Harding, John Eldon (Jun. '43), Private, U.S. Army, 715 South 11th St., New Castle, Ind.

Hardman, Robert Lyon (Assoc. M. '43), Capt., Corps of Engrs., U.S. Army, Box 1371, Balboa, Canal Zone.

Hinshaw, Carl (Assoc. M. '43), Member of Congress, House of Representatives, U.S. 1506 House Office Bldg., Washington, D.C. (Res., 3053 Lombardy Rd., Pasadena, Calif.)

Hjalmarson, Conrad (Jun. '43), Akra, N.Dak.

Hoffman, Edward Stephen (Jun. '43), Weight Analyst, Goodyear Aircraft Corp., 1210 Massillon Rd. (Res., 476 Hillwood Drive), Akron 3, Ohio.

Hoge, William Morris (M. '43), Brig.-Gen., U.S. Army, 9th Armored Div., Army Post Office 259, Care, Postmaster, Los Angeles, Calif.

Holloway, Joseph Ogburn (Assoc. M. '43), Chf. Draftsman, State Highway Dept. (Res., 262 Cloverdale Rd.), Montgomery 6, Ala.

Holman, John Adam (Jun. '43), With U.S. Army, 226 East Franklin St., Anderson, S.C.

Humphreys, Richard Brown (Jun. '43), 2d Lt., Antiaircraft Artillery, U.S. Army, 37[illegible] Drake Ave., Cincinnati, Ohio.

Jeffrey, Neill Pressley, Jr. (Jun. '43), Jeanerette, La.

Jennings, Royce Merlyn (Jun. '43), Ensign, U.S.N.R., Greenwich, Ohio.

Johnson, Roy Ernest (Jun. '43), Engr., Design Group, Douglas Aircraft Co., Inc., El Segundo (Res., 4026 Duquesne Ave., Culver City), Calif.

Jones, William Mathias (Jun. '43), 2d Lt., U.S. Army, 395th A.F.A. Battalion, 10th A[illegible] Division, Camp Chaffee, Ark.

Karekin, Kissag Gregory (Assoc. M. '43), Warrant Officer, CEC, U.S.N.R., 98th Battalion, Port Hueneme, Calif.

Karpoff, Konstantine Pavlovich (Assoc. M. '43), Asst. Engr., Dept. of Interior, U.S. Bureau of Reclamation, Box 499, Grants Pass, Ore.

Kasler, Clinton Eugene (Assoc. M. '43), Project Mgr., Western Cont. Corp., 2100 East 4th St., Sioux City, Iowa.

Kearney, George William (Assoc. M. '43), Engr. (San.), U.S. Engr. Office, Peoples Bldg., Charleston, S.C.

Kennon, Frank Walter (Assoc. M. '43), Asst. Hydr. Engr., U.S. Geological Survey, 2[illegible] Federal Bldg. (Res., 3319 North 11th St.), Tacoma 6, Wash.

Khoury, Esa Michael (Jun. '43), Private First